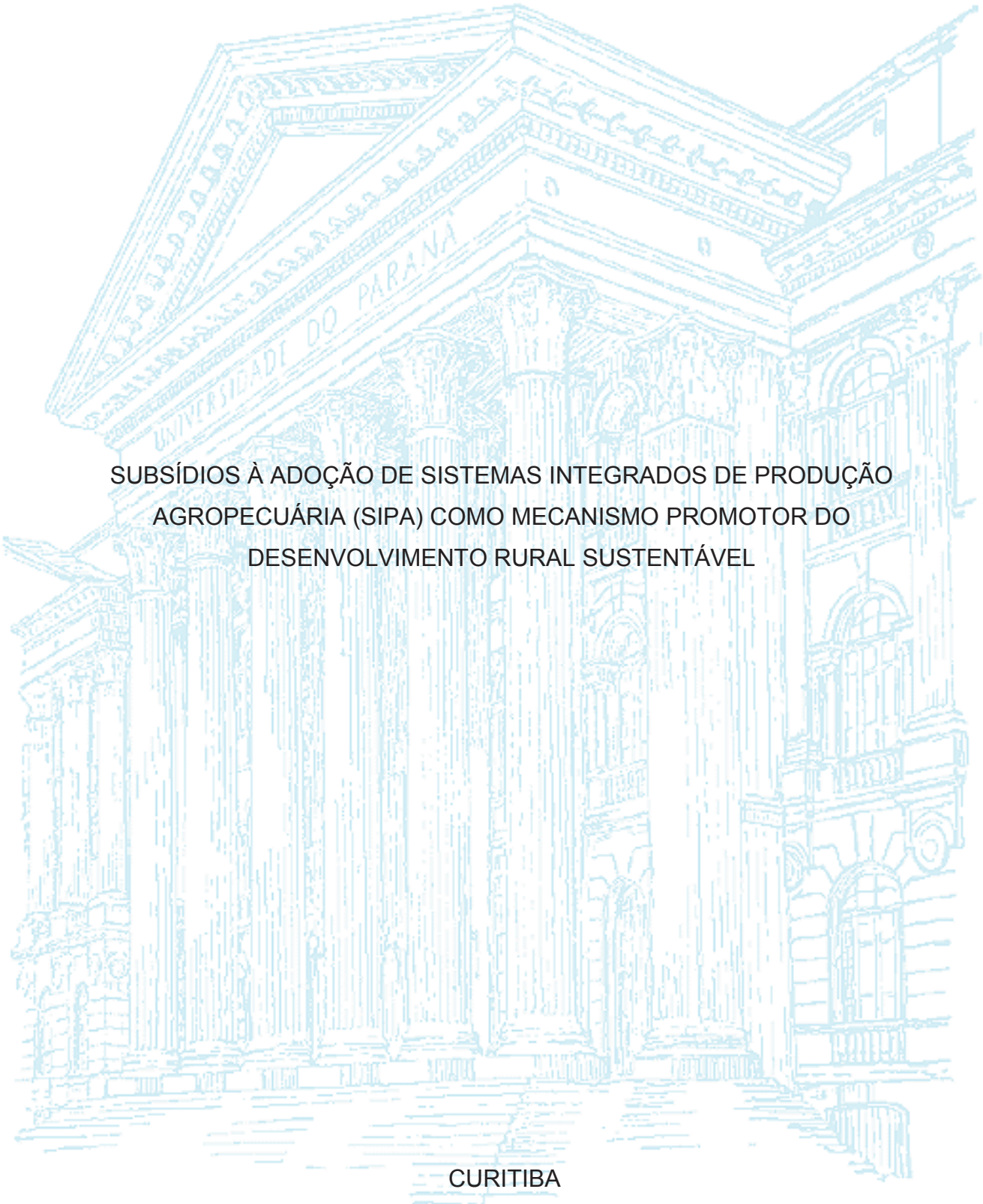
UNIVERSIDADE FEDERAL DO PARANÁ

RAFAEL ARAÚJO BONATTO



SUBSÍDIOS À ADOÇÃO DE SISTEMAS INTEGRADOS DE PRODUÇÃO AGROPECUÁRIA (SIPA) COMO MECANISMO PROMOTOR DO DESENVOLVIMENTO RURAL SUSTENTÁVEL

CURITIBA

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Tese apresentada ao Programa de Pós-Graduação em Agronomia, Área de concentração em Produção Vegetal, Setor de Ciências Agrárias, como parte das exigências para a obtenção do título de Doutor em Ciências.

Orientador: Prof.ª Dra. Raquel R.B. Negrelle
Co-orientador: Prof. Dr. Aníbal de Moraes

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Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação em AGRONOMIA (PRODUÇÃO VEGETAL) da Universidade Federal do Paraná foram convocados para realizar a arguição da tese de Doutorado de **RAFAEL ARAUJO BONATTO** intitulada: **SUBSÍDIOS À ADOÇÃO DE SISTEMAS INTEGRADOS DE PRODUÇÃO AGROPECUÁRIA (SIPA) COMO MECANISMO PROMOTOR DE DESENVOLVIMENTO RURAL SUSTENTÁVEL**, após terem inquirido o aluno e realizado a avaliação do trabalho, são de parecer pela sua APROVAÇÃO no rito de defesa.

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Curitiba, 28 de Fevereiro de 2018.

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A toda minha família e àqueles que trabalham por um mundo melhor.

Dedico.

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“A cada passo, um agradecimento.”

(Marilda do Rocío Bonatto)

RESUMO

Visando contribuir para o melhor entendimento dos sistemas integrados de produção agropecuária (SIPA) como mecanismos promotores de desenvolvimento rural sustentável, são apresentados os resultados de pesquisa onde se buscou: a) Verificar fortalezas e debilidades do SIPA referenciado por 109 critérios de sustentabilidade definidos pela FAO; B) Avaliar a capacidade do SIPA como mecanismo promotor de processos de desenvolvimento rural em propriedades da agricultura familiar; C) Identificar a capacidade dos SIPA em promover a meta de desenvolvimento sustentável no. 2 da ONU, pertinente ao combate à fome, promoção da segurança alimentar e melhoria da nutrição, no âmbito da agricultura familiar. Para tanto, duas iniciativas público-privada de extensão rural (PISA e PISACOOP), promotoras de SIPA no Brasil, foram avaliadas. Neste processo, foram utilizadas as metodologias SAFA e SAFA Smallholders App., desenhadas pela Agência das Nações Unidas para a Agricultura e Alimentação – FAO. A SAFA engloba 109 indicadores de sustentabilidade, divididos em 21 temas e 58 subtemas relacionados a quatro dimensões: 1. Boa governança, 2. Integridade ambiental, 3. Resiliência econômica, e 4. Bem-estar social. A SAFA Smallholders App.é um instrumento específico para avaliação de sistemas agrícolas familiares. Evidenciou-se: A) Considerando 246 propriedades avaliadas nos estados de RS e SC, Bom a Ótimo desempenho foi identificado para o PISA nas quatro dimensões da sustentabilidade. Considerando os 109 indicadores avaliados, escore menor que moderado não foi identificado, com 49% destes obtendo a classificação “Boa”. Os maiores escores estão relacionados à dimensões da Boa Governança e Bem estar Social. Foi evidenciado que o PISA apresentou fraquezas nas quatro dimensões avaliadas, com maior porcentagem para os indicadores “Moderados” associados a dimensão da Integridade Ambiental (36%) e Resiliência Econômica (31%). As implicações destes resultados são discutidas. B) A partir da análise de 56 propriedades rurais distribuídas em 26 municípios da região sul do Brasil (Território Cantuquiriguaçu e municípios pertencentes ao Território Paraná - Centro), evidenciou-se que 64% dos agricultores avaliados demonstravam possuir aptidão à adoção das metodologias e tecnologias propostas pelo programa PISACOOP. Apenas 20%

dos indicadores pertinentes ao desempenho das entidades pertencentes ao ambiente institucional dos municípios beneficiados pelo programa obtiveram escore “Baixo”. Entretanto, alguns limitantes foram verificados durante as fases de desenho da iniciativa PISACOOP. Frente aos resultados obtidos, discutem-se as implicações das lacunas evidenciadas e apresentam-se recomendações no sentido de apoiar a adequada implantação e manutenção de SIPA como ferramenta ao desenvolvimento rural. C) A avaliação de 407 propriedades, em 22 municípios do estado de RS, utilizando-se SAFA Smallholders APP, permitiu evidenciar que 86% dos indicadores avaliados alcançaram os maiores escores possíveis, quatro foram classificados como “Inaceitáveis” e sete obtiveram o escore “Moderado”. Na circunstância observada, a iniciativa em SIPA (programa PISA) forneceu evidencias que a suportam como alternativa ao cumprimento do ODS 02 da ONU, quando implantado à agricultura familiar. As implicações destes resultados são discutidas. Adicionalmente, em virtude da natureza inovadora da ferramenta SAFA Smallholders App., uma analise do seu uso é apresentada. A avaliação derivou da experiência acumulada ao longo de sua aplicação em 407 propriedades rurais distribuídas em 7 municípios do Estado do Rio Grande do Sul, região sul do Brasil. Durante a análise, constatou-se que SAFA Smallholders é uma ferramenta prática e viável de avaliação de campo; no entanto, 4% de seus indicadores apresentam adversidades quanto à definição de padrões de classificação e variáveis propostas. Sugestões são apresentadas com o objetivo de esclarecer o ponto de vista do autor e revelar possíveis adaptações de ferramentas.

Palavras-chave: Segurança alimentar, sustentabilidade agropecuária.

ABSTRACT

In order to contribute to a better understanding of the integrated crop livestock systems (ICLS) capacity of promoting sustainable rural development, this research presents the following objectives: a) Check the strengths and weaknesses of the ICLS referenced by 109 sustainability criteria defined by FAO; B) Evaluate the capacity of the ICLS as a mechanism that promotes rural development processes in family farming properties; C) Identify the capacity of ICLS to promote United Nations sustainable development goal 2 (UN SDG02) related to the fight of hunger, promotion of food security and the improvement of nutrition in the context of family farming. Therefore, two pro ICLS public-private rural extension initiatives in Brazil, (PISA and PISACOOP), were evaluated. In this process, SAFA and SAFA Smallholders App. methodologies designed by the United Nations Agency for Food and Agriculture (FAO) were used. SAFA includes 109 sustainability indicators, divided into 21 themes and 58 sub-themes related to four dimensions: 1. Good governance, 2. Environmental integrity, 3. Economic resilience, and 4. Social welfare. SAFA Smallholders App. is a specific instrument for evaluating family farming systems. It was evidenced: A) Considering 246 properties evaluated in the RS and SC States, “Good” to “Best” performance was identified for PISA in the four dimensions of sustainability. Considering the 109 indicators evaluated a score lower than “Moderate” was not identified, with 49% of these being classified as "Good". The highest scores were related to the dimensions of Good Governance and Social Wellbeing. It was evidenced that PISA presented weaknesses in the four dimensions evaluated, with a higher percentage for the "Moderate" indicators associated with the Environmental Integrity (36%) and Economic Resilience (31%) dimensions. The implications of these results are discussed. B) Based on the analysis of 56 rural properties distributed in 26 municipalities in the southern region of Brazil (Cantuquiriguaçu Territory and municipalities belonging to the Paraná - Centre Territory), 64% of the evaluated farmers demonstrated their ability to adopt methodologies and technologies proposed by the PISACOOP program. Only 20% of the indicators pertaining to the performance of its institutional arrangement organizations obtained a "Low" score. However, some limitations were verified during the design phases of the PISACOOP initiative. In view of the results obtained, the implications of the identified gaps are discussed and recommendations are made to support the adequate implementation and maintenance of ICLS as a tool for rural development promotion. C) The evaluation of 407 properties in 7 municipalities in the State of Rio Grande do Sul, using SAFA Smallholders APP, showed that 86% of the evaluated indicators reached the highest possible scores, four were classified as "Unacceptable" and seven obtained the " Moderate". In the observed circumstance, the ICLS initiative (PISA program) provided evidence supporting it as an alternative to accomplish the UN SDG 02, when implemented in smallholder farmers. The implications of these results are discussed.

Additionally, due to the innovative nature of the SAFA Smallholders App. tool, an analysis of its use is presented. The study derived from the experience gathered over its application measuring sustainability levels in 407 rural properties distributed in seven municipalities of Rio Grande do Sul State, southern Brazil. Over the analysis it was found that SAFA Smallholders App. is a practical and feasible field evaluation tool; however, 4% of its indicators have presented adversities regarding the definition of classification patterns and indicator variables. Suggestions are presented with the aim of clarifying the author's stand point and unearth possible tool adaptations.

Keywords: Food security, agricultural sustainability.

FIGURAS

TABELAS

ABREVIATURAS E SIGLAS

ABC	Agricultura de Baixa Emissão de Carbono
ATER	Assistência Técnica e Extensão Rural
CAPES	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior
CODETEC	Conselho desenvolvimento território Cantuquiriguaçu
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse Gas
IBGE	Instituto Brasileiro de Geografia e Estatística
ICLS	Integrated Crop Livestock Systems
IFAD	International Fund for Agriculture Development
ILF	Integração Lavoura e Floresta
ILP	Integração Lavoura e Pecuária
IPF	Integração Pecuária e Floresta
ILPF	Integração Lavoura, Pecuária e Floresta
ISO	International Standardization Organization
MAPA	Ministério da Agricultura, Pecuária e Abastecimento
NITA	Núcleo de Inovação Tecnológica em Agropecuária
ONU	Organização das Nações Unidas
PGAPV	Programa Pós Graduação em Agronomia e Produção Vegetal
PISA	Programa de Produção Integrada em Sistemas Agropecuários
PISACOOP	Programa de Produção Integrada em Sistemas Agropecuários e Cooperativismo
RAS	Rural Advisory Services
RISE	Response Induced System Evaluation
SAFA	Sustainability Assessment of Food and Agriculture Systems
SAFA APP	Sustainability Assessment of Food and Agriculture Systems APP.
SALSA	System Analysis for Sustainable Agriculture
SIPA	Sistemas Integrados de Produção Agropecuária
SEBRAE	Serviço brasileiro de apoio às micro e pequenas empresas
SMA	Secretaria municipal de agricultura
SOFI	State of Food Insecurity
UFPR	Universidade Federal do Paraná
UFRGS	Universidade Federal do Rio Grande do Sul
UNEP	United Nations Environmental Program

SUMÁRIO

INTRODUÇÃO GERAL

A partir da década de 1950, a intensificação do uso dos recursos naturais pela agropecuária passou a comprometer os serviços ecossistêmicos em especial aqueles pertinentes à conservação da biodiversidade e da qualidade dos solos e água (BALBINO, et. al. 2011; SANDERSON, et. al. 2013; FRANZLUEBBERS et al., 2014). Modelos agropecuários de produção outrora difundidos e com base numa racionalidade apenas econômica, levaram à sobre-especialização das atividades agropecuárias além dos limites da sustentabilidade (PEYRAUD et al., 2014).

Desta forma, conciliar a produção de alimentos, fibras e biocombustíveis, com a preservação dos recursos naturais (BRUSSARD, 2010; GODFRAY, 2014), utilizando se dos princípios da intensificação sustentável e de outras vertentes conservacionistas, tornou-se um desafio sem paralelo.

Em resposta a este cenário, foram propostos os sistemas integrados de produção agropecuária (SIPA). Tal abordagem produtiva tem sido reconhecida como modelo de agricultura sustentável embasado nas complementaridades existentes entre as atividades integradas e pelo seu potencial de ciclagem de nutrientes e serviços de ecossistêmicos (LEMAIRE et al., 2014).

Fundamentado nos conceitos e definições de sistemas de produção no contexto agrícola de Hirakuri et al. (2012), um sistema integrado de produção agropecuária pode ser definido como a integração de estruturas de cultivo ou de criação de diferentes finalidades em uma mesma área, interligados por um processo de gestão, visando maximizar o uso da terra e dos meios de produção, bem como diversificar a renda.

Visando homogeneizar o conceito destes sistemas produtivos entre os países pertencentes à Organização das Nações Unidas (ONU), sua Agência para Alimentação e Agricultura (FAO) definiu a seguinte acepção para o termo SIPA (FAO, 2010): “A integração pode ser na fazenda, bem como em uma região produtora, podendo ocorrer alguma forma de especialização produtiva”. “Formas bem-sucedidas de integração abarcam uma integração intencional que reflita relações sinérgicas entre os componentes de culturas, animais e/ou árvores; e que esta relação, quando apropriadamente manejada, resulte em aprimoramento da sustentabilidade social (inclusão da comunidade),

econômica e ambiental e melhore as condições de vida daqueles agricultores que a manejem".

Segundo MAZOYER e ROUDART (2010) os primeiros sistemas agrários da história humana derivam da revolução agrícola neolítica. Ela ocorreu quando o homem caçador-coletor originou sociedades de cultivadores, fenômeno provavelmente associado ao clássico desequilíbrio entre a renovação dos recursos naturais e seu uso pelo homem (DIAMOND, 2005). Um dos primeiros registros da integração de cultivos com a produção animal data de 9000 a.C., na cidade de Jericó. Segundo van Keulen e Shiere (2004), a Bíblia (Gen. 4) sugere que Caim tinha por responsabilidade o cultivo de grãos; enquanto Abel cuidava dos animais.

No Brasil, registros históricos que se referem aos sistemas agrários dos séculos XVII e XVIII já descreviam modelos de SIPA. Linhares (1995) relata um sistema tido como "peculiar e eficaz", em que o gado era integrado a cultivos de fumo e mandioca. O termo Integração Lavoura-Pecuária (ILP) foi usado por Medeiros (1978 *apud* MEDEIROS, 1973), ao sugerir o uso de bovinos de corte em áreas de cultivos de trigo e soja no Planalto do Rio Grande do Sul. Moraes et al. (2014) avaliaram que a última evolução do SIPA, nacionalmente, foi provocada pela tecnologia do plantio direto, quando a pecuária passou a ter por desafio que se adaptar a sistemas profundamente direcionados a práticas conservacionistas.

No que diz respeito a sua importância à segurança alimentar, os SIPA produzem 50% dos cereais, 34% da carne bovina e 30% do leite. Quase um bilhão de pessoas dependem destes sistemas como fonte primaria para sua subsistência (DUNCAN et al. 2013). No continente africano, os sistemas integrados de produção desempenham um papel igualmente importante como fonte de suprimento alimentar (HERRERO et al., 2010). Naquele continente, este modelo agropecuário é o principal contribuinte em termos de ocupação da mão de obra e suporte à produção de alimentos (HERRERO et al., 2013).

De acordo a EMBRAPA (2016), no Brasil a área com algum tipo de adoção de sistemas integrados abrange 11,5 milhões, o que é equivalente a 4,84% dos 237,5 milhões de hectares ocupados pelas atividades agropecuárias, representando o potencial de expansão deste modelo nas áreas agrícolas brasileiras.

Na esfera nacional os SIPA compõe o pilar principal de dois programas governamentais de extensão rural denominados PISA e PISACOOP. Estas iniciativas trazem em seu arcabouço técnico a proposta de atuação de forma integrada, sistêmica (Produção Integrada de Sistemas Agropecuários – PISA), (SIA, 2016).

Esta metodologia foi desenvolvida pelo MAPA, como forma de utilizar ferramentas e Assistência Técnica e Extensão Rural (ATER), que proporcionem inovação tecnológica, utilizando a intensificação sustentável, sem colocar em riscos os produtores e suas propriedades, como fomento e difusão de tecnologias de produção sustentável para propriedades rurais (CARVALHO, 2013; FRANZLUEBBERS et al., 2014; SCHUMPETER, 1985; VEIGA, 2010; VIEIRA, 2015).

O PISA se utiliza dos Sistemas Integrados de Produção Agropecuária (SIPA), como modelo para produção de alimentos seguros, visando ampliar as interações ecológicas e sustentáveis nos diferentes processos, tais como uso do solo, com ciclagem de nutrientes, como forma de melhorar a qualidade deste e ampliar a biodiversidade, preservando os recursos naturais e o meio ambiente (CARVALHO, 2013; CARVALHO et al., 2014; LEMAIRE et al., 2014; MORAES et al., 2014).

O Programa PISA teve início em 2008 com a constituição de um Comitê Técnico Gestor (CTG), tendo acontecido na região das Missões (cidade de Guarani das Missões) e a implantação da metodologia se deu em uma Unidade de Difusão Tecnológica (UDT), em uma propriedade leiteira no município de São Nicolau – Unidade PISA Granja Ortiz (CARVALHO et al., 2011; CARVALHO, 2013; CARVALHO et al., 2016).

Dito programa foi implantado no Rio Grande do Sul em 2011 (Figura 01) por meio de parceria estabelecida entre o Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (SEBRAE), Ministério da Agricultura, Pecuária e Abastecimento (MAPA), Serviço Nacional de Aprendizagem Rural (SENAR) e Federação da Agricultura do Rio Grande do Sul (FARSUL), sendo sua execução no campo realizada por empresas e consultores especializados, utilizando a metodologia PISA (PALADINI, 2017).

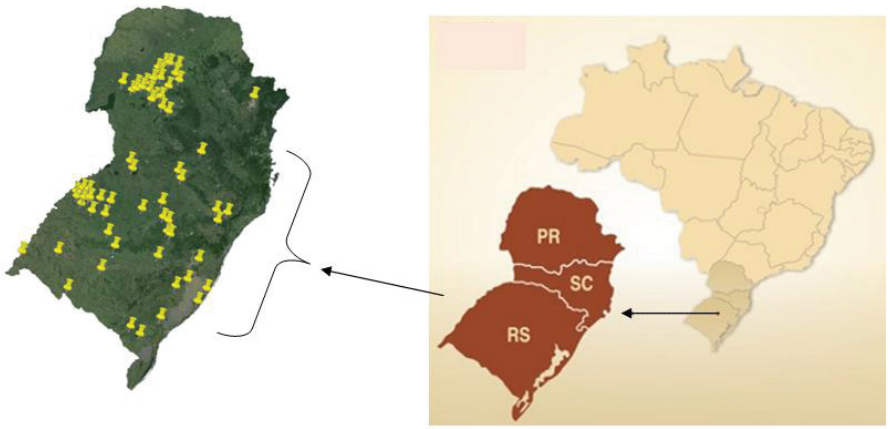

Figura 1: Localização das propriedades participantes do programa de produção integrada em sistemas agropecuários (PISA), Brasil. Fonte: SIA, 2017.

Cabe sublinhar que as características intrínsecas aos SIPA não garantem sua sustentabilidade como modelo de produção agropecuária (BEHLING et. al., 2014). Barreiras como a carência de conhecimentos técnicos necessários à implantação e gestão destes sistemas, por parte dos produtores rurais e técnicos, são realidades comumente vivenciadas no Brasil (GASPARINI, 2017).

Sob a ótica atinente à promoção dos processos de desenvolvimento rural sustentável, o investimento sustentado em tecnologia para o aumento da produtividade na agricultura tem um grande impacto tanto no crescimento econômico como na redução da pobreza (FAN et al., 1999, 2002; FAN, 2008), sendo uma das forças mais confiáveis e potentes ao desenvolvimento social e econômico (FAO, 2017).

Neste cenário, a transformação rural inclusiva depende da agricultura, o que mantém a sua importância à medida que a transformação se desenrola, mas exige que políticas agrícolas distintas sejam adotadas em diferentes estágios da transformação rural (IFAD, 2016).

Convergindo com essa premissa, no Brasil a adoção de SIPA vem sendo fomentada em linha de crédito especifica pelo programa ABC (Agricultura de baixa Emissão de Carbono - artigo 3° do Decreto n° 7.390/2010). O programa ABC é uma política publica galgada na organização e planejamento de ações visando à redução da emissão de gases de efeito

estufa procedentes da agropecuária por meio da promoção de SIPA e outras praticas agrícolas (MAPA, 2017).

Para que os impactos consequentes da promoção e implantação de modelos agropecuários promotores do desenvolvimento rural sustentável sejam corretamente identificados e mensurados, se faz necessário o emprego de instrumentos e métodos de avaliação holística da sustentabilidade agropecuária. Tais ferramentas se apresentam fundamentais ao entendimento dos desafios da promoção da sustentabilidade como eixo norteador da produção agroalimentar (TALUKDER et. al., 2017).

Atualmente existem vários instrumentos que se propõem a avaliar a sustentabilidade agropecuária, alguns possuem maior enfoque em mecanismos já consagrados como é o caso do projeto SALSA (*Systems Analysis for Sustainable Agriculture*) o qual visa à elaboração e o desenvolvimento de ferramentas de monitoramento com base em numa abordagem de pensamento pautado na "Análise do Ciclo de Vida" (KAMALI et. al., 2017).

Seguindo tais tendências, o Colégio Suíço de Agricultura desenvolveu a ferramenta denominada RISE (*Response Inducing Sustainability Evaluation*). Este instrumento utiliza parâmetros embasados nos princípios da ISO 14040 para a analise do Ciclo de Vida dos produtos Agropecuários e dos processos produtivos adotados nas propriedades rurais e demais setores do agronegócio (OUDSHOORN, 2014).

Instituições de ensino superior como a Universidade britânica de Aberdeen, na figura do Professor Doutor Jon Hillier em colaboração com a empresa Unilever e Sustainable Food Lab, desenvolveu a ferramenta nomeada *"Cool Farm"* para a avaliação de emissão de gases do efeito estufa procedente de atividades agropecuárias. A ferramenta é um instrumento disponível online e recentemente foi ampliada para medir impactos da agropecuária nos recursos hídricos e na biodiversidade, permitindo que os agricultores identifiquem e simulem distintos cenários produtivos (SYKES et. al., 2017).

Segundo Sanchez e Matos (2012), na década de 1990, a partir dos trabalhos iniciais da FAO, ocorreu uma proliferação de conjuntos de indicadores de sustentabilidade da agricultura. Contudo, os desafios enfrentados na seleção e desenho dos indicadores levaram à procura e ao

desenvolvimento de abordagens que permitissem guiar o processo de análise da sustentabilidade.

Assim, cabe evidenciar que é comum a utilização de indicadores de produção e produtividade agropecuária e de determinados indicadores de qualidade ambiental para a comunicação dos benefícios de sistemas agrícolas, com frequência olvidando os demais aspectos abrangidos pela sustentabilidade destes sistemas (DE OLDE et. al., 2017).

Como implicação deste cenário, pouco se sabe sobre o emprego de indicadores destinados à mensuração dos distintos aspectos sob o sustentáculo de uma avaliação holística e integrativa de indicadores em modelos como SIPA (BONAUDO et. al., 2014; RYSCHAWY et. al., 2014).

Estando ciente que os sistemas de avaliação existentes permanecem fragmentados no que concerne à avaliação das cadeias agroalimentares, a FAO apresentou no ano de 2013 a ferramenta intitulada SAFA (*Sustainability Assessment of Food and Agriculture systems*). Dado instrumento visa preencher a lacuna existente entre as ferramentas específicas, estabelecendo uma referência internacional para a avaliação dos custos de oportunidades das suas dimensões, propondo uma abordagem holística durante seus processos de implantação e avaliação (FAO, 2013). A visão orientadora da SAFA é que os sistemas alimentares e agrícolas em todo o mundo são caracterizados por quatro dimensões da sustentabilidade: a boa governança, a integridade ambiental, a resiliência econômica e o bem-estar social.

Tal instrumento foi preparado para que as organizações sejam elas empresas ou pequenos produtores, envolvidos com a produção, transformação, distribuição e comercialização de bens tenham uma compreensão clara dos componentes constituintes da sustentabilidade. As diretrizes apresentadas pela ferramenta são o resultado de um processo interativo, construído sobre as comparações cruzadas de códigos de boas práticas, relatórios corporativos, padrões, indicadores e outros protocolos técnicos. A ferramenta fornece protocolos para a avaliação da sustentabilidade ao longo 21 temas, 58 subtemas e 116 indicadores, relacionados a quatro dimensões: 1. Boa governança, 2. Integridade ambiental, 3. Resiliência econômica, e 4. Bem-estar social. A SAFA Smallholders App.é um instrumento específico para avaliação de sistemas agrícolas familiares (FAO, 2013).

A partir do exposto, visando contribuir para o melhor entendimento dos sistemas integrados de produção agropecuária (SIPA) como mecanismos promotores de desenvolvimento rural sustentável, realizou-se avaliação de dois programas brasileiros PISA e PISACOOP. Para tanto, foram utilizadas as metodologias SAFA e SAFA Smallholders App. Os resultados destas análises são apresentados no presente documento.

No primeiro capítulo, apresenta-se resultado da avaliação de fortalezas e debilidades do PISA, implantado em 246 propriedades distribuídas em 24 municípios de dois estados do sul do Brasil: Rio Grande do Sul e Santa Catarina.

No segundo capítulo, apresenta-se o resultado da avaliação da capacidade do PISACOOP como mecanismo promotor de processos de desenvolvimento rural em propriedades da agricultura familiar. Foram analisadas 56 propriedades, em 26 municípios dos territórios Cantuquiriguaçu e Paraná Centro, no Estado do Paraná.

No terceiro capítulo, apresenta-se o resultado da análise da capacidade dos PISA em promover a meta de desenvolvimento sustentável no. 2 da ONU, pertinente ao combate à fome, promoção da segurança alimentar e melhoria da nutrição, no âmbito da agricultura familiar. Foram avaliadas 407 propriedades rurais, distribuídas em 12 municípios do Rio Grande do Sul.

Adicionalmente, dada a natureza inovadora desta nova ferramenta e seu amplo potencial de uso na avaliação de iniciativas de sistemas de produção sustentáveis, é apresentada uma análise da aplicação do SAFA Smallholders App. A análise derivou da experiência acumulada ao longo de sua aplicação, medindo níveis de sustentabilidade em 407 propriedades rurais distribuídas em 7 municípios do Rio Grande do Sul, região sul do Brasil. Durante a análise, constatou-se que SAFA Smallholders é uma ferramenta prática e viável de avaliação de campo; no entanto, 4% de seus indicadores apresentam adversidades quanto à definição de padrões de classificação e variáveis indicadoras. Sugestões são apresentadas com o objetivo de esclarecer o ponto de vista do autor e desenterrar possíveis adaptações de ferramentas.

Conclui-se este documento com sugestões e recomendações para incrementar a adequação do PISA e PISACOOP frente à perspectiva do desenvolvimento rural sustentável.

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1 STRENGTHS AND WEAKNESSES OF THE INTEGRATED CROP-LIVESTOCK SYSTEMS (ICLS) ON PROMOTING SUSTAINABLE DEVELOPMENT – AN ANALYSIS OF THE BRAZILIAN INTEGRATED PRODUCTION PROGRAM IN AGRICULTURAL SYSTEMS (PISA).

ABSTRACT

Although several scientific studies that seek to better understand the benefits from integrated crop livestock systems (ICLS) approach have been increasing, few of them were actually conducted with a holistic approach. In aiming to contribute to the better understanding of the contributions of ICLS as a model to promote sustainable agriculture, we present the results of an analysis of a governmental led ICLS program using FAO sustainability indicators through discussing its strengths and weaknesses. Data were collected through document and literature reviews, individual and group interviews and field visits. These were analyzed using the Sustainability Assessment of Food and Agriculture systems (SAFA), encompassing 109 sustainability default indicators, divided in 21 themes and 58 subthemes related to four dimensions: a) good governance, b) environmental integrity, c) economic resilience and d) social well-being. Overall, the good to best performance of PISA was identified, through considering 21 themes that integrate the four sustainability SAFA dimensions. Considering all 109 indicators, a lower score than moderate was not identified, with predominantly good scores for the majority of the indicators (49%). The highest scores of PISA were related to the overall social well-being and governance dimensions; as well as, the soil quality and animal welfare sub-themes, under the environmental integrity dimension. It was evidenced that PISA showed weaknesses in all four sustainability dimensions, with a higher percentage of indicators associated with lower (moderate) scores observed for the environmental integrity (36%) and economic resilience (31%) dimensions. The implications of these results are discussed.

Key words: Rural Development, food security, good governance, environmental integrity, economic resilience, social well-being.

1.1 INTRODUCTION

Currently, there is a growing demand for an outset, adaptation and consequently democratization of good farming practices amongst farmers, scientific community and consumers worldwide (ROCKSTRÖM et. al., 2017; WALTER et. al., 2017). Such assertion is directly convergent with the strategies towards ending hunger and malnutrition on the global scale (IFAD, 2016).

For instance, maintaining local and international food security, adapting sustainable livelihoods and ensuring the sustainable intensification of crop and livestock production; especially in smallholder crop-livestock systems as well as in other food production systems is paramount (GODFRAY, 2017).

Harnessing the potential of well-integrated crop and livestock systems across the spectrum (on-farm and area-wide), is one of the prevailing entry points to address the rural and urban society´s needs, issues and opportunities (FAO, 2014; FORESIGHT, 2011).

Integrated crop livestock systems (ICLS), imply a diverse range of integrated ecological, biophysical, socio economic conditions, which have been a foundation of agriculture for hundreds of years (GARRETT, et. al., 2017).

ICLS are planned systems involving temporal and spatial interactions on different scales with animal and crop exploitation within the same area, simultaneously or disjointedly and in rotation or succession (MORAINE et. al., 2017). ICLSs aim to achieve synergism with emergent properties as a result of soil–plant–animal–atmosphere interactions that ensure economic and ecological sustainability while providing ecosystem services (MORAES et al., 2014).

In Brazil, the ICLSs started as a punctual and disperse process at the end of the 19th century, mainly in the southern temperate subtropics; particularly in the classical arrangement of flooded rice fields and native grasslands in Rio Grande do Sul (MORAES et al, 2014). Overtime, it has evolved into a national integrated production program in agricultural systems, known as PISA, which was designed and implemented by the Brazilian Ministry of Agriculture, Livestock and Supply (MAPA, 2014).

As mentioned by this institution, it is a whole-farm management program focused on the reduction of social inequalities and to achieve

economic development through sustainable production systems, including good agriculture and the integration of crop-livestock, using technological innovations.

As advocated by its mentors, such a program was not oriented to any specific agricultural sector or product and was designed under the pillars of conservation agriculture, animal welfare, integrated crop-livestock systems, among other good farming practices (MAPA, 2015).

So far, the PISA program has been implemented in Paraná, Santa Catarina and Rio Grande do Sul states from southern Brazil. It encompasses ~1000 small stakeholders over 57 municipalities, consisting mainly of small dairy farmers.

This experience has been both studied and documented from different perspectives. However, the vast majority of results were related to plant production, focusing on the yield of annual crops (MORAES et al., 2013). Not often studies actually involve the soil, animals and other components.

These same studies were also limited in scope and integration between ecological factors, and although a number of scientific studies that seek to better understand the program have increased, few of them were conducted with a systemic and holistic approach (MORAES et al., 2013).

Furthermore, until recently, the PISA program has not being subjected to a global and deep analysis of all different dimensions of sustainability, including the economic or sociocultural feasibility as oriented by FAO (FAO 2013).

Throughout the sustainability analysis of the Brazilian PISA program, this research aims to contribute to a better understanding of the benefits of ICLS as a model to promote sustainable agriculture under the SAFA / FAO defended premises on sustainability indicators and metrics. The results are presented through discussing both its strengths and weaknesses.

1.2 MATERIALS AND METHODS

The PISA analysis was performed using mainly primary data from current formal program documents, individual and group interviews and field visits. Secondary data from peer-reviewed publications related to the project were additionally used to fulfil the sustainability analysis.

The interviews were targeted to cover different levels of the PISA, from its design to stages of its implementation. In total, the PISA general coordinators were interviewed at national level (n=1) and at state level (n=3), the Rural Advisory Services (RAS) technicians (n=10), and the program beneficiaries from the region where the program was implemented (57 municipalities in 2 states- Santa Catarina e Rio Grande do Sul in Southern Brazil).

All program beneficiaries that were identified as being at the end of the 3-year PISA contract were visited and interviewed (n= 246). Field visits covered a broad range of property types ($\bar{x}$=17,5±5 ha, minimum size= 3 ha, maximum size= 500 ha represented by 1 property). All of identified as ICLSs dealing with cattle raising and mixed cropping agriculture, with 98 % categorized as dairy farm, 2% as beef producers; as well as, 93% considered to be family farmers (small-scale enterprises)1.

In general, dairy cows were fed on maize silage + concentrate (60-70% of the diet) and annual temperate (mainly *Lolium multiflorum* and *Avena strigosa*) or tropical pastures (mainly *Sorghum bicolor, Pennisetum glaucum,* and *Cynodon species*) (30-40% of the diet). Soybean, maize, bean, eucalyptus, tobacco, yerba mate, forage crops, silage and hay were the main crop productions.

Almost 98% of the interviews had the participation of both female and male property owners. The interviewed cohort covered a wide variety of ages ($\bar{x}$=50±3 ha, minimum= 22 years, maximum= 80 years).

The data analysis was performed using the Sustainability Assessment of Food and Agriculture Systems (SAFA) tool, operationalized by the SAFA software version 2.2.402 following the directions described in SAFA Guidelines VERSION 3.0 (FAO, 2013). In total, the analysis included 109 sustainability default indicators, divided into 21 themes and 58 subthemes related to four dimensions of sustentability: a) good governance, b) environmental integrity, c) economic resilience and d) social well-being (Table 1).

[1] Accordantly to the Brazilian current legislation, family farmers are defined as those that meet the following criteria: property size up to 72 ha (Southern Brazilian region), use mainly family labour for production and, family income highly dependent on farming activities (Brasil, 2006).
[2] Available at http://www.fao.org/nr/sustainability/sustainability-assessments-safa

Table 1.1: SAFA sustainability dimensions, themes and subthemes, applied on the analysis 246 rural properties of the Program on Integrated Agricultural Production Systems (PISA) in Santa Catarina and Rio Grande do Sul States, Southern Brazil.

Dimensions	***Themes***	***Subthemes***
Good Governance	Corporate Ethics	Mission Statement, Due Diligence.
	Accountability	Holistic Audits, Responsibility And Transparency.
	Participation	Stakeholder Dialogue, Grievance Procedures And Conflict Resolution.
	Rule Of Law	Legitimacy, Remedy, Restoration & Prevention Civic Responsibility And Resource Appropriation.
	Holistic Management	Sustainability Management Plan And Full-Cost Accounting.
Environmental integrity	Atmosphere	Greenhouse Gases And Air Quality
	Water	Water Withdrawal And Water Quality
	Land	Soil Quality And Land Degradation
	Biodiversity	Ecosystem Diversity, Species Diversity And Genetic Diversity
	Materials And Energy	Material Use, Energy Use And Waste Reduction & Disposal
	Animal Welfare	Animal Health And Freedom From Stress
Economic resilience	Investment	Internal Investment Community Investment Long-Ranging Investment and Profitability.
	Vulnerability	Stability of Production, Stability of Market, Stability of Supply
	Product Quality and Information	Liquidity and Risk Management.
		Food Safety, Food Quality and Product Information.
	Local Economy	Value Creation and Local Procurement
Social Well-being	Decent Livelihood	Quality of Life, Capacity Development and Fair Access to Means of Production.
	Fair Trading Practices	Responsible Buyers and Rights of Suppliers.
	Labour Rights	Employment Relations, Forced Labour, Child Labour and Freedom of Association and Right to Bargaining.
	Equity	Non Discrimination, Gender Equality and Support to Vulnerable People.
	Human Health and Safety	Workplace Safety and Health and Provisions Public Health.
	Cultural Diversity	Indigenous Knowledge and Food Sovereignty.

The SAFA tool considers three types of indicators. Performance indicators (22%) are those with a direct measurement, utilizing primary data from the operation itself, or otherwise calculating the actual impacts of the operation on the sustainability issue. Practice-based indicators (70%) are those that identify certain practices which, based on general industry consensus or secondary data (such as scientific evidence), have been determined to be a proxy for a certain level of performance and thus considered “better practice”. Target indicators (8%) were referred to indicators regarding the existence of a plan or policy with a particular sustainability target, such as “GHG reduction by

10 percent". The intention behind these indicators is that the enterprise has a plan with a target that matches the SAFA sustainability goal for that sub-theme.

Target indicators were collected directly with program designers, Practice indicators were obtained with the Rural Advisory Services (RAS) technicians; and lastly, the Performance indicators were gathered and checked with farmers during on-site visits. Almost all indicators have a 5- scale rating for performance: best (percentage scores = 80-100%); good (60-80%); moderate (40-60%); limited (20-30%) and unacceptable (0-20%).

Since all sub-themes are weighted equally, it was necessary to weigh indicators in instances where multiple indicators exist at the sub-theme level. When sub-themes only had one indicator, no weighting was necessary.

The performance analysis was made considering the features defined on the "How to measure" and "Rating" steps presented at the "SAFA Indicators" document (FAO, 2013). In some indicators, for example social well-being, the interviewed actors qualified the indicator performance using their own concept and understanding. These varied between 0% and 100%, which were then further transferred into the SAFA software.

The analysis considered the exceptions defined by the SAFA tool. These were adjusted in places to allow room for small-scale producers, so that high sustainability scores might still be reached without requiring the use of performance indicators, especially in the environmental dimension of the SAFA assessment (FAO, 2013).

1.3 RESULTS

In general, an overall good to best performance of PISA was identified, considering all the 21 themes that integrate the four sustainability SAFA dimensions (Figure 1.1).

Considering all the 109 indicators, a score lower than moderate was not identified, with predominantly good scores found for the majority of indicators (49%). The highest scores of PISA were related to the overall social well-being and governance dimensions. Nevertheless, it was evidenced that PISA had weaknesses in all four sustainability dimensions.

The higher percentage of indicators identified within lower (moderate) scores, were those belonging to environmental integrity (36%) and economic resilience (31%) dimensions.

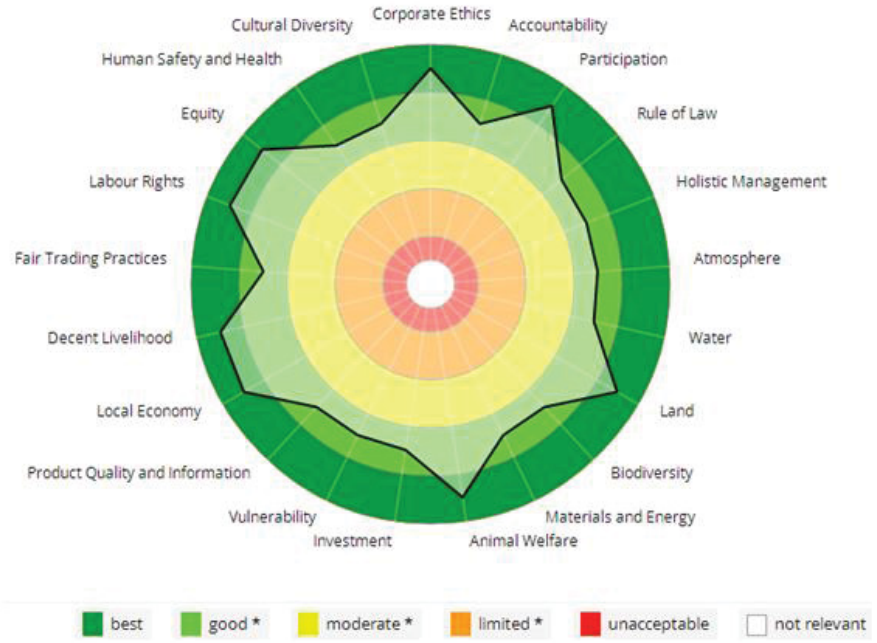

Figure 1.1 General performance of the Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul, Southern Brazil using SAFA analysis (2015).

Along with the good performance registered for 79% of the indicators linked to the good governance dimension, the results suggest that the highest levels of acceptance and involvement were actually attained by stakeholders.

However, some weaknesses of PISA were detected that could negatively impact the program and threaten its prosperity as the absence of a formal sustainability plan drawn by PISA proponent institution.

Another concerning issue detected on the good governance dimension of sustainability is associated to the methodology employed for the farmer's selection which has not followed any formal procedure as those suggested on the SAFA guidelines. Furthermore, the holistic audits, accountability and responsibility were not monitored internally in an appropriate manner as required by the SAFA indicator Guidelines (Figure 1.2).

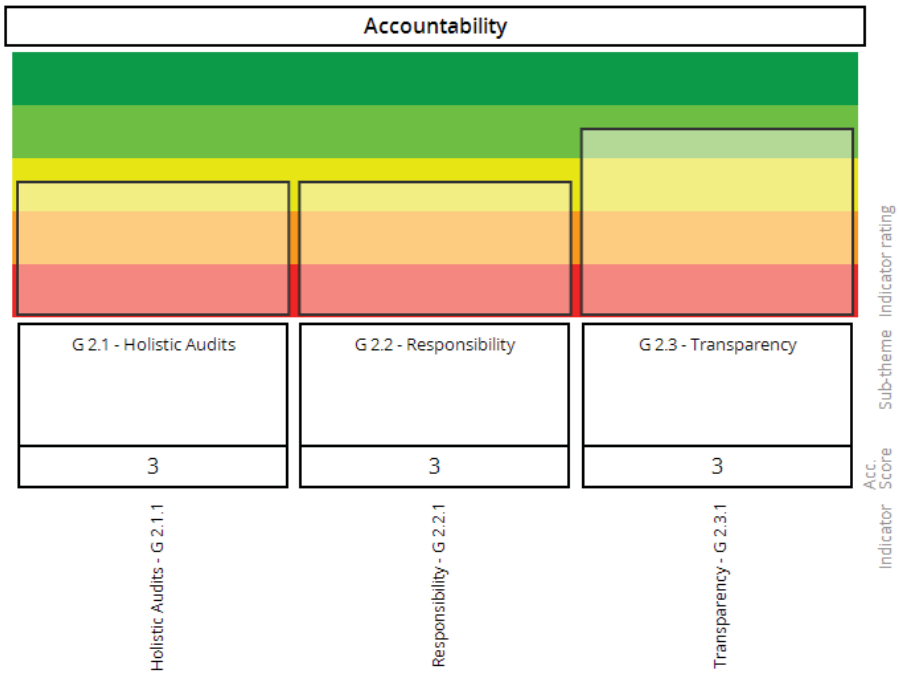

Figure 1.2 Accountability theme/ Good Governance dimension- SAFA analysis of the PISA- Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul States, Southern Brazil (2015).

In what is related to the Environmental integrity dimension of sustainability, PISA was able to provide the best conditions for plant growth and soil health.

In terms of animal welfare, PISA showed high performance rates as it ensured that animals were kept under species-appropriate conditions. These include: freedom from hunger, thirst, discomfort, pain, fear or stress; as well as, injury and disease.

Regarding the organic waste usage and recycling, the absence of important practice such as soil composting application was detected. This technique is commonly used to enhance the soil organic matter content, to stimulate biological activity and to promote nutrient recycling, as a consequence, those benefits may be misused by the properties.

Waste reduction and disposal, were also evidenced as important strengths. Participant producers did properly manage recyclable wastes generated onsite. Overall, a dearth of written plans that usually sets quantifiable and binding targets for the prevention and reduction of waste generation has diminished the grade of the PISA program on such scale (Figure 1.3).

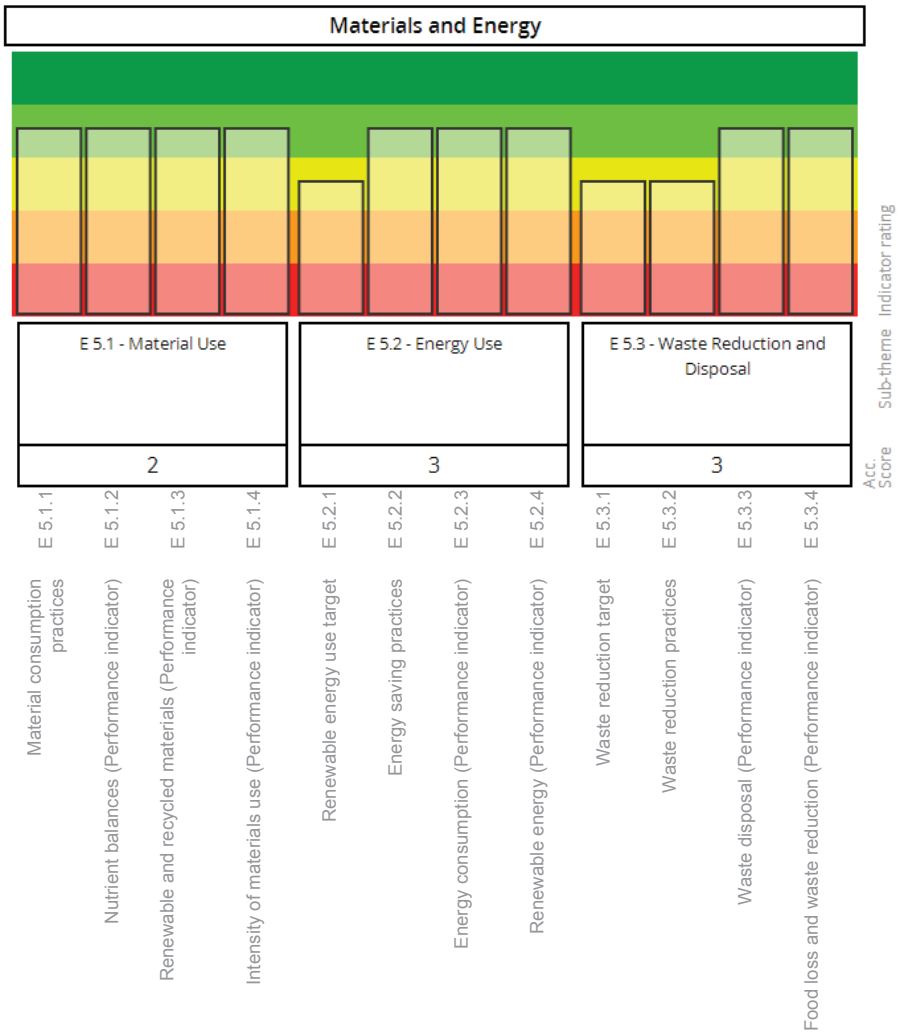

Figure 1.3 Environmental integrity dimension / Material and Energy theme, subthemes -SAFA analysis of the PISA- Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul States, Southern Brazil (2015).

Other important absences on the environmental dimension include: clear targets for the reduction of greenhouses gases and air pollution; as well as, water and biodiversity conservation (Figure 1.4). Although the program implemented steps for reducing and preventing air pollution and greenhouse gases, these were not part of a formal program target.

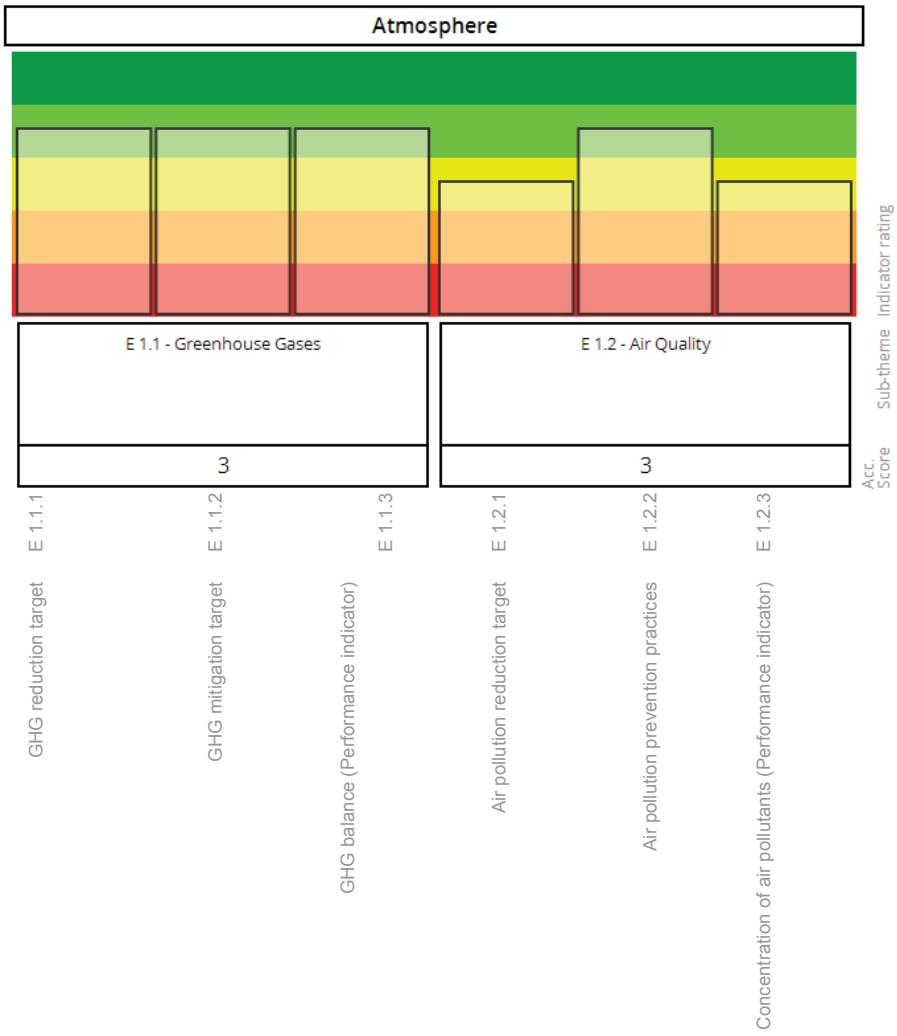

Figure 1.4 Environmental integrity dimension / Atmosphere theme - SAFA analysis of the PISA- Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul States, Southern Brazil (2015).

Actions to promote genetic diversity and in situ conservation, materials and energy usage were implemented in a right manner, although it was not put into formal written plan classifying those indicators as moderate in the Environmental integrity dimension.

In what is related to biodiversity, the program had promoted and implemented local nature conservations and restoration practices in all the participant farms; however, it also does not possess formal written plans and targets specifying the formal procedures encompassed by those practices (Figure 1.5).

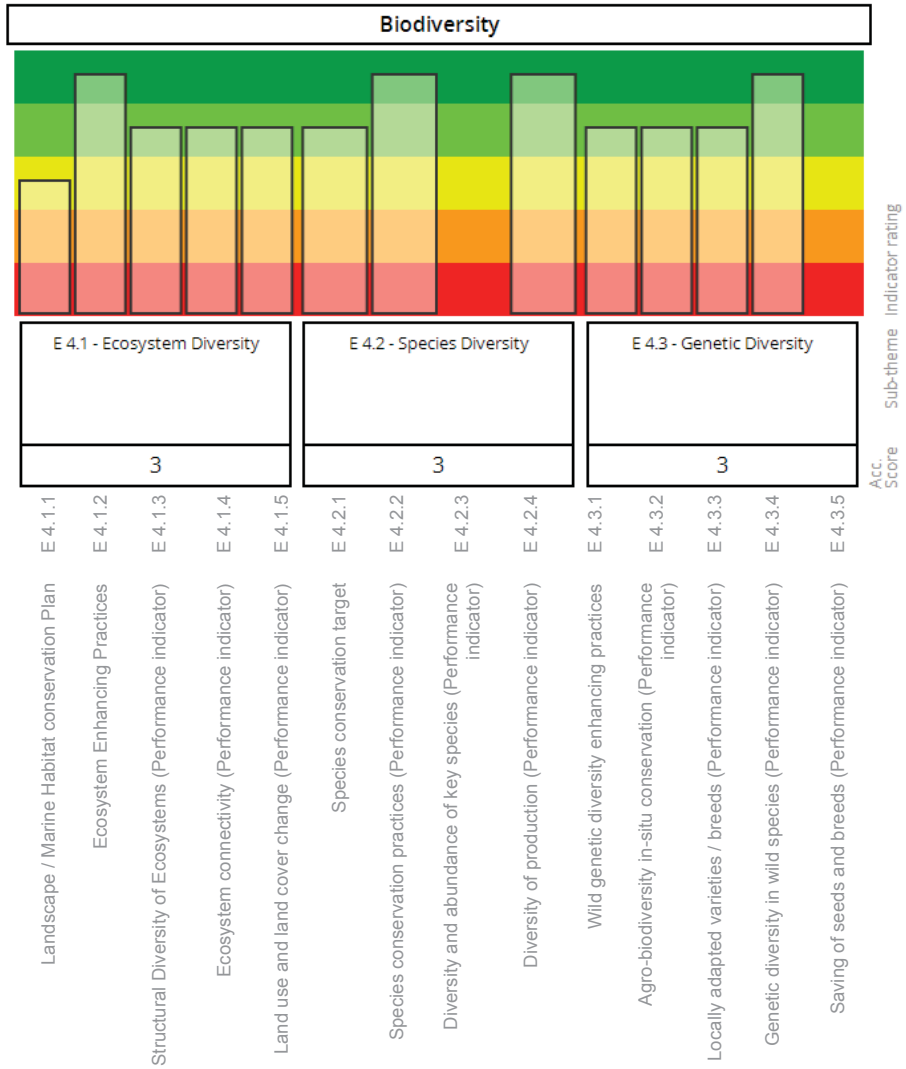

Figure 1.5 Environmental integrity dimension / Atmosphere theme- SAFA analysis of the PISA- Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul States, Southern Brazil (2015).

In reference to economic resilience dimension of sustainability, the best scores were related to the investment theme. Other economic resilience indicators with best scores were related to profitability (net income) and liquidity (net cash flow), along with local economic development though generation of employment opportunities and fiscal contributions.

The lower scores of the economic resilience dimension of sustainability were mostly due to a lack of business planning along with informal approaches to determining the cost of production and other price determinants.

Hence, PISA had neither designed nor implemented a marketing strategy to identify potential consumers that could purchase the producer's products and goods at a reasonable price via legitimate payment conditions.

The risk management performance indicators revealed another weakness of the PISA program (Figure 1.6). The market and production volatility, credit risk, disease and natural disasters related to climate change are just some of the precarious factors that the PISA program participants might face.

Such attributes were poorly qualified, perhaps due to the program lacking in set actions and mechanisms towards preventing or reducing the extent to which the enterprise is exposed to internal and external risks, assessing its likelihood of incidence, in order to mitigate potentially negative impacts.

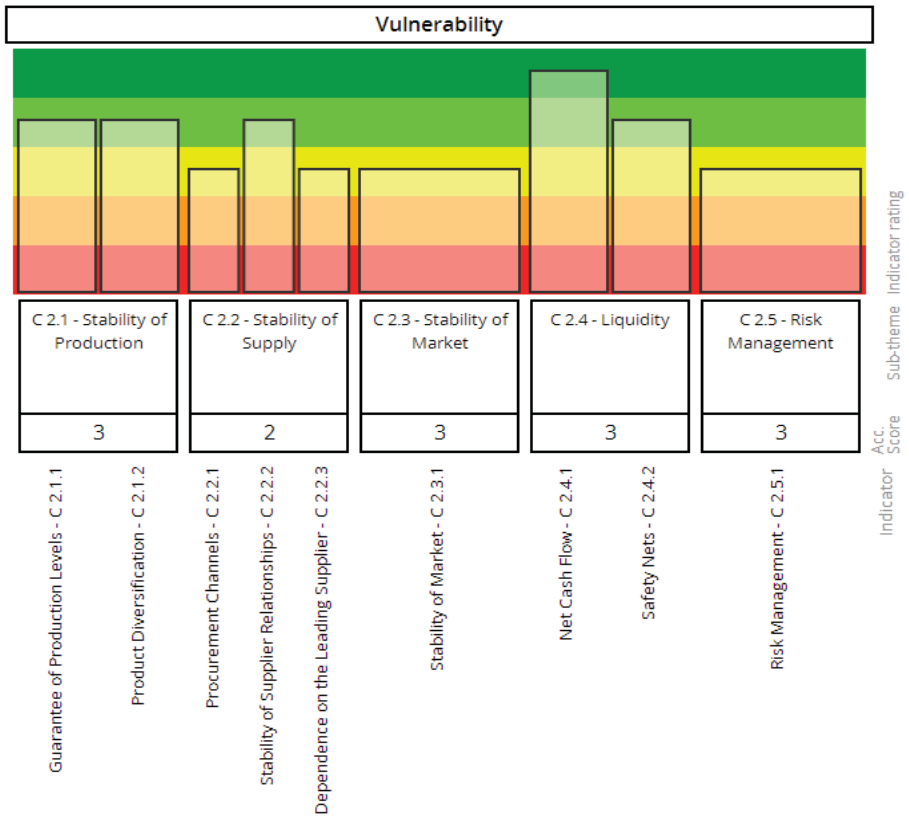

Figura 1.6 Economic resilience dimension Vulnerability theme - SAFA analysis of the PISA- Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul States, Southern Brazil (2015).

Another weakness was related to the product quality and information (Figure 1.7).

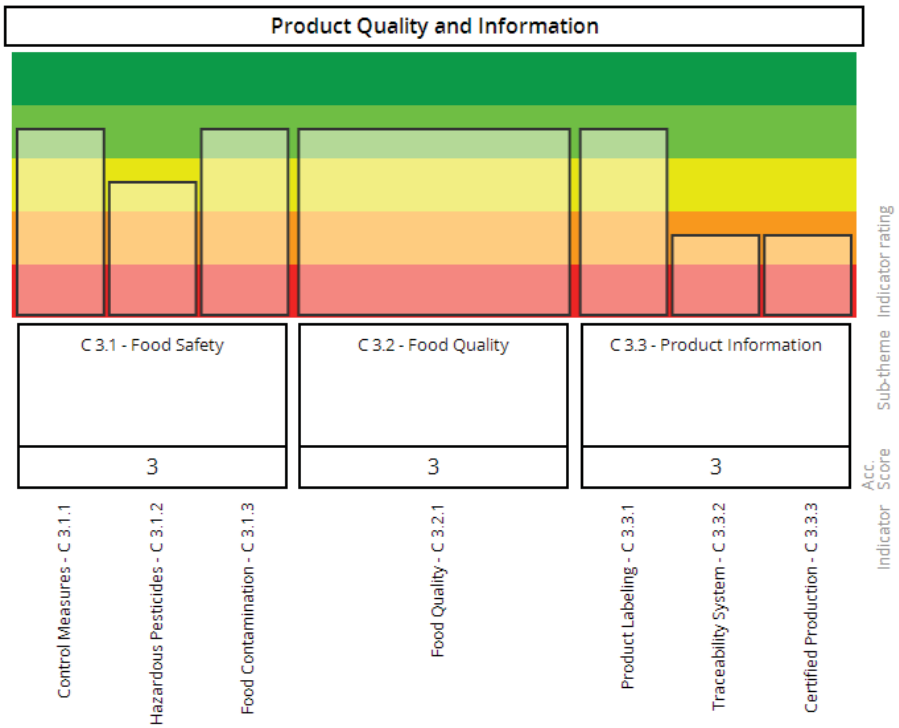

Figure 1.7 Economic resilience dimension / Product quality and information theme, subthemes and its pertaining indicators sustainability performance - PISA program in Santa Catarina and Rio Grande do Sul States of southern Brazil (Brazil, 2015).

In terms of the Social Wellbeing, “Best” performance was perceived for 47% of the evaluated features, but it has not determined any position with the support of indigenous knowledge employment on its strategy (Figure 1.8).

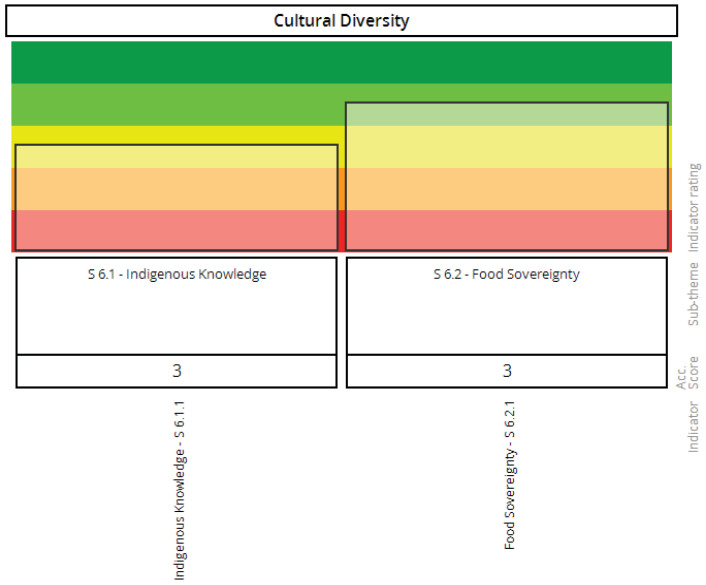

Figure 1.8 Social Wellbeing dimension / Cultural diversity theme- SAFA analysis of the PISA- Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul States, Southern Brazil (2015).

The indicators of Safety and health trainings and Safety of working place, operations and facilities obtained “Moderate” scores (Figure 1.9).

Figure 1.9 Social Wellbeing dimension / Human Safety and Health theme- SAFA analysis of the PISA- Program on Integrated Agricultural Production Systems in Santa Catarina and Rio Grande do Sul States, Southern Brazil (2015).

1.4 DISCUSSION

The results elucidated that under the FAO terms PISA encompassed the first steps towards a promotion of agricultural sustainability. On the whole, PISA provided adequate levels of satisfaction concerning basic human needs and the provision of rights and the freedom, to satisfy one´s aspirations for a better life, as recommended by FAO (2012).

Moreover, this signifies that PISA avoided behaviours that could result in poor health, emotional distress and conflict as well as, the maintenance of social structures and cultural values paving the way to promote social well being of project participants.

Given that, human well-being is important in the quest for ecological sustainability and social justice, because it helps in determining how best to use

the limited material available, whilst simultaneously identifying what other non-material factors are also important (SUSTAINABLE SCALE, 2016).

However, to fully achieve the social well-being dimension, the PISA program must better fill a gap related to human health and safety, since the program did not have a work place risk assessment plan (farmer's property) that could identify and suggest work safety environmental improvements.

The PISA participant farmers have expressively increased their milk production along the implementation period, but such production increment was not accompanied with a labour and time related management. This circumstance might set a tough challenge to participant producers in particular, because such target groups are characterized as aging populations, whose physical activity is somewhat limited by labour force within a short time frame (JAFFE, 2015).

Hence, economic prosperity essentially depends on the size and quality of the workforce. As people pass through their 50s and beyond, the likelihood of them participating in the labour force tends to decrease (BOERSCH, 2008). The combination of both labour markets tightening and possible dissaving, raises concerns that steeply aging countries will experience slower economic growth (BLOOM et. al. 2011).

The PISA had a clear commitment to stakeholder engagement and participation and was therefore able to identify vulnerabilities amongst this cohort. The program institutional arrangement allowed equal stakeholder participation on decision-making, especially in the context of activities implemented onsite – at property level.

Concerning the program stakeholder's participation and their effective governance, it must be underlined that those aspects are critical to ensure the benefits for both people and the planet. There is a direct correlation between good governance and higher well-being scores. In general, this relation is considered as a virtuous cycle that produces good social outcomes as well as high-quality economic growth, suggesting that there are "institutional roots of sustainability" as pointed out by Colford (2015).

However, on what is related to the processes of choosing the participant farmers it was not planned neither incorporated a territorial analysis

of priority demands. Consequently, it may have masqueraded the representativeness of the program at local level (KOOPMANS et. al., 2017).

In what pertains to the sustainability report indicator, according to Kitzmueller and Shimshak (2012), if a business implements its sustainability report accurately, completely, and timely, it is able to increase its productivity and efficiency through process optimization and the enterprises are more likely to flourish from an improved image and a better reputation (BARON, 2008).

The indicator related to Waste Reduction and Disposal under the Environmental Integrity dimension of sustainability has received a moderate score as the management and employment of soil compost was not promoted by the program.

According to Diacono and Montemurro (2010), soil compost increases the soil organic matter (SOM) content, which enhances aggregation and stability, therefore ameliorating soil structure. Moreover, increasing SOM levels promotes carbon sequestration (FAVOINO; HOGG, 2008).

Conclusive evidence postulates that improved biological activity, enhanced nutrient availability for plants (BOLDRIN et al., 2009), and the suppression of soil borne diseases (BONANOMI et al., 2007), are all potential benefits of implementing compost application.

Fostering holistic approaches to waste management has positive consequences for GHG emissions in regards to the energy, forestry, agriculture, mining, transport, and manufacturing sectors (UNEP, 2010).

The absence of formal procedures on GHG and atmospheric pollutants emission target, might not distinguish the PISA production from ‘conventional’ production, which is generally standardized for broad commodity groups where little or no information is given regarding place or conditions under which the product was produced (SONNINO; MARSDEN, 2006).

Neglect of these targets may therefore impose a certain level of danger to the program, as it may likely become impossible to obtain an environmental certification, requiring additional document controlling and verification procedures.

Such circumstances could undervalue the program´s production and ongoing commitment towards global sustainable development strategies.

The moderate scores related to workplace safety and health coverage on the Social Wellbeing Dimension of sustainability were obtained due to the lack of promoted activities regarding those practices.

It might pose an important threat as the small and medium sized enterprises like a smallholder property are more susceptible of having a higher risk of occupational hazards and a lower ability to control those risks when compared to larger enterprises (JØRGENSEN ET AL., 2010; MICHELI AND CAGNO, 2010).

With reference to the Profitability indicator of the Economic Resilience Dimension of sustainability, the paucity of proper procedures involving the production cost assessment, could possibly implicate to incorrectly determining break-even points.

This scenario would result in the diminution of a farmer’s profits and under certain extreme circumstances, perhaps even lead to non-economic viability, jeopardizing producer activities.

In addition, it was not clear whether a structured set of actions and mechanisms might prevent or reduce the extent to which the enterprises were exposed to internal and external risks as well as its likelihood of incidence, along with ways towards reducing its possible negative impacts.

Besides universal, common to most types of business risks, such as operational risk, credit risk and market risk, agricultural holdings are exposed to risk due to the nature of agricultural activity itself, which are highly related to environmental conditions over which a man has no control (VERMEULEN; COTULA, 2010).

Another important shortage was related to certification procedures. Certification has the potential to improve commodity producers' environmental performance (BLACKMAN; NARANJO, 2012). In theory, this can be achieved by enabling the consumer to differentiate among commodities based on their environmental attributes. The lack of a set of procedures might pose a threat to PISA, especially considering its potential to facilitate price premiums and better market access for certified producers.

1.5 CONCLUSIONS

With some adjustments on its environmental and economic dimensions of sustainability, it was evidenced that integrated crop livestock systems, under the approach sustained by the PISA program in Southern Brazil, can be recognized as a model that could be used to answer the challenges regarding the FAO statement on sustainable agriculture promotion.

Albeit, the employment of SAFA tool was positively observed as a feasible and realistic instrument for agriculture sustainability scenario definition and thus, its usage could be considered advantageous to the identification of strengths and weaknesses of agriculture systems.

Hence, the broad protection provided by the SAFA tool, could be considered applicable as a formal instrument for PISA´s certification.

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2 SUSTENTABILIDADE DE SISTEMAS INTEGRADOS DE PRODUÇÃO AGROPECUÁRIA NA PERSPECTIVA DA PROMOÇÃO DO DESENVOLVIMENTO RURAL NO ESTADO DO PARANÁ – REGIÃO SUL DO BRASIL

RESUMO

Os sistemas integrados de produção agropecuária (SIPA) têm reconhecida sua capacidade de promoção da intensificação sustentável da produção agropecuária. Contudo, são limitadas as evidências de que estes sistemas produtivos possam atuar como ferramentas à promoção dos processos de desenvolvimento rural. Visando subsidiar a adoção de SIPA como mecanismo promotor de processos de desenvolvimento rural, apresenta-se resultado de avaliação da sustentabilidade do programa PISACOOP, abrangendo 56 propriedades rurais distribuídas em 26 municípios da região sul do Brasil (Território Cantuquiriguaçu e municípios pertencentes ao Território Paraná - Centro) utilizando se de entrevistas estruturadas e observações não participativas como ferramentas metodológicas. 64% dos agricultores avaliados demonstraram possuir aptidão à adoção das metodologias e tecnologias propostas pelo programa PISACOOP e 20% dos indicadores pertinentes ao desempenho das entidades pertencentes ao ambiente institucional dos municípios beneficiados pelo programa obtiveram escore “Baixo”. Entretanto, alguns limitantes foram verificados durante as fases de desenho da iniciativa PISACOOP. Frente aos resultados obtidos, discutem-se as implicações das lacunas evidenciadas e apresentam-se recomendações no sentido de apoiar a adequada implantação e manutenção de SIPA como ferramenta ao desenvolvimento rural.

Palavras-chave: Desenvolvimento sustentável, Participação Social, Desenvolvimento Rural.

INTEGRATED CROP LIVESTOCK SYSTEMS SUSTAINABILITY IN THE PERSPECTIVE OF RURAL DEVELOPMENT PROMOTION IN THE STATE OF PARANA – SOUTHERN REGION OF BRAZIL

ABSTRACT

Integrated Crop Livestock Systems (ICLS) have recognized their capacity to promote the sustainable intensification of agricultural production. However, there is limited evidence that these productive systems can act as tools for the promotion of rural development processes. Aiming to subsidize the adoption of SIPA as a mechanism to promote rural development processes, the results of the sustainability evaluation of the PISACOOP program are presented, covering 56 rural properties distributed in 26 municipalities in the southern region of Brazil (Cantuquiriguaçu Territory and municipalities belonging to Paraná Centro Territory) using structured interviews and non-participatory observations as methodological tools. 64% of the evaluated farmers were able to adopt the methodologies and technologies proposed by the PISACOOP program and 20% of the indicators pertaining to the performance of the entities belonging to the PISACOOP institutional arrangement obtained a "Low" score. However, some limitations were verified during the design phases of the initiative. In view of the results obtained, the implications of the identified gaps are discussed and recommendations are made to support the adequate implementation and maintenance of SIPA as a tool for rural development.

Keywords: Sustainable Development, Social Participation, Rural Development.

2.1 INTRODUÇÃO

Os sistemas integrados de produção agropecuária (SIPA) são reconhecidos como um potencial modelo de produção promotor da intensificação sustentável (HERRERO et.al., 2010; TARAWALI et. al., 2011; SOUSSANA, et.al., 2014; LEMAIRE et. al., 2014).

Segundo a agência das Nações Unidas para a Agricultura e Alimentação – FAO, um SIPA pode ser definido como um modelo integrado de produção, em nível de propriedade rural ou em uma área ampla, podendo envolver algum tipo de especialização.

Ainda, um SIPA bem sucedido envolve uma integração intencional que reflete uma relação sinérgica entre os componentes presentes nas culturas agrícolas, produção pecuária e / ou árvores e que essa relação sinérgica, quando administrada de forma adequada, resulta em maior sustentabilidade social econômica e ambiental, melhorando os meios de subsistência dos agricultores que os administram (FAO, 2010).

No âmbito internacional, os SIPA produzem a maior parte do leite e da carne de gado consumidos e são particularmente importantes para os meios de subsistência e segurança alimentar das parcelas mais pobres da população nos países em desenvolvimento (THORNTON & HERRERO, 2014).

Quanto às características ambientais, Sulc e Franzluebbers (2014) enfatizam a complexidade ecológica dos SIPA e o seu potencial promotor de serviços ecossistêmicos e de preservação da biodiversidade.

Contudo, os aspectos positivos deste modelo de produção agropecuário não garantem o sucesso de iniciativas promotoras dos processos de desenvolvimento rural que os endossam como ferramenta produtiva.

Explorando o termo desenvolvimento rural, percebe se que o mesmo extrapola o conceito de produção e produtividade, estando associado à ideia de criação e desenvolvimento de capacidades humanas, políticas, culturais e técnicas (DA VEIGA, 2016).

Estes processos visam permitir às populações rurais agir para transformar e melhorar suas condições de vida, por meio de mudanças em suas relações com as esferas do Estado, do mercado e da sociedade civil (BRASIL, 2013).

Segundo Schneider e Gazolla (2011), projetos e programas que se propõe a promover o desenvolvimento do meio rural devem reconhecer os agricultores como atores sociais capazes de responder afirmativamente aos desafios e questões colocadas em sua época. Desta forma, seria reconhecida a essencialidade de sua participação nas distintas fases de iniciativas desta natureza.

Ainda, a aceitabilidade e prévio conhecimento do beneficiário assim como o ambiente institucional favorável onde programas e projetos se desenvolvem são elementos chaves neste contexto (FAURÉ & HASENCLEVER, 2007). Outro elemento de valor inquestionável está relacionado ao atendimento das expectativas dos beneficiários, que devem estar adequadamente contempladas no projeto base (MLA, 2002).

O bom desempenho destes projetos pode ser atribuído principalmente à implantação de uma abordagem participativa equilibrada que impulsiona as capacidades individuais e coletivas dos habitantes rurais por meio da melhoria das comunicações, organização de grupos e associações de base e treinamento (FAO / IFAD, 2014).

No que concerne às questões limitantes à adoção de SIPA no território brasileiro, a Empresa Brasileira de Pesquisa Agropecuária (RICHETTI, 2014), identificou, por meio de estudos, várias dificuldades encontradas pelos agricultores e pecuaristas. Dentre elas se destacaram as dificuldades com máquinas e equipamentos (36,7%), mão de obra capacitada (19,5%) e o manejo da pastagem (14,2%).

Visando subsidiar a adoção de SIPA como mecanismo promotor de processos de desenvolvimento rural, apresenta-se resultado de avaliação da sustentabilidade do programa PISACOOP, abrangendo 56 propriedades rurais distribuídas em 26 municípios da região sul do Brasil (Território Cantuquiriguaçu e municípios pertencentes ao Território Paraná - Centro).

Especificamente, objetivou-se responder os seguintes questionamentos: A capacidade dos potenciais beneficiários era compatível para a adoção das metodologias e tecnologias propostas pelo projeto? O ambiente institucional favorecia a implantação e manutenção do projeto?

Frente aos resultados obtidos, discutem-se as implicações das lacunas evidenciadas e apresentam-se recomendações no sentido de apoiar a

adequada implantação e manutenção do PISACOOP como ferramenta ao desenvolvimento rural.

2.1 MATERIAL E MÉTODOS

O Projeto PISACOOP – Cantuquiriguaçu e Paraná Centro

O Projeto PISACOOP – Cantuquiriguaçu e Paraná Centro é uma iniciativa do Ministério da Agricultura, Pecuária e Abastecimento (MAPA) e a Universidade Federal do Paraná (UFPR). Implantado em 2014, tem enfoque embasado na adoção de práticas como o SIPA, princípios da agricultura de conservação e da intensificação sustentável (BRASIL, 2014), estando suas ações condicionadas ao horizonte temporal (ciclo de vida do projeto) de 36 meses, tendo finalizado em dezembro de 2017.

O projeto deriva do programa denominado PISA (Programa de Produção Integrada em Sistemas Integrados), iniciativa desenhada no ano de 2007 pelo MAPA e UFPR. Nesta nova roupagem, o projeto prima pela promoção do cooperativismo entre os agricultores beneficiários (PISACOOP, 2016). Neste modelo agropecuário, os serviços de assistência técnica e extensão rural (ATER) possuem caráter participativo e equitativo onde se sublinha a essencialidade da participação do agricultor na definição das ações implantadas em sua propriedade rural (PISACOOP, 2016). No que diz respeito ao público alvo, o programa PISACOOP advoga não possuir segmento específico segundo a tipologia adotada para o setor na esfera nacional (Brasil 11.326/2006).

O projeto PISACOOP - Cantuguiriguaçu englobava 56 propriedades rurais distribuídas em dois Territórios da Cidadania[1], localizados no Estado do Paraná, a saber: Território Cantuquiriguaçu (36 propriedades distribuídas em 20 municípios) e Território Paraná - Centro (20 propriedades distribuídas em oito municípios) (Fig.2.1).

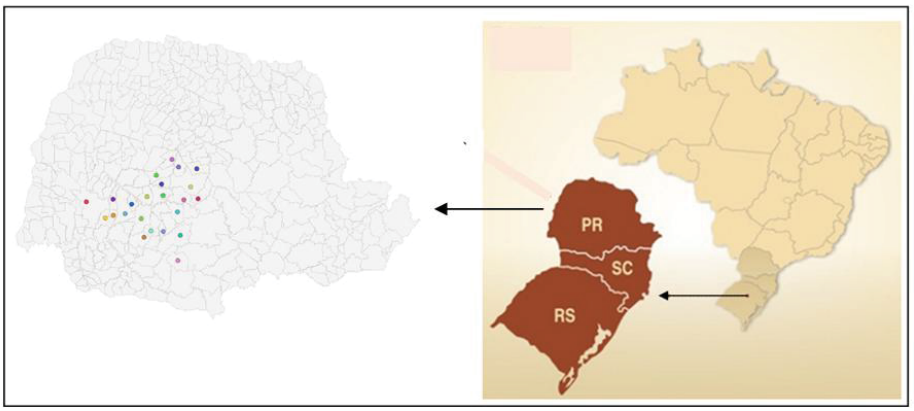

Figura 2.1 Localização da área de abrangência do Projeto PISACOOP – Território Cantuquiriguaçu e Paraná Centro. Fonte: Landsat, 2015.

O Território Cantuquiriguaçu engloba 20 municípios totalizando 13.986,40 Km², com 232.729 habitantes (IBGE, 2010), dos quais 107.473 vivem na área rural (46,22%). Possui 21.184 agricultores familiares, 4.264 famílias assentadas, 4 comunidades quilombolas e 1 terra indígena. Seu IDH médio é 0,72 (BRASIL, 2017, CONDETEC, 2009).

O Território Paraná Centro - PR engloba 18 municípios totalizando 15.045,50 Km. A população total do território é de 341.696 habitantes, dos quais 108.788 vivem na área rural (31,84%). Possui 23.167 agricultores familiares, 2.040 famílias assentadas, 2 comunidades quilombolas e 3 terras indígenas. Seu IDH médio é 0,73 (BRASIL 2017, CONDETEC, 2009).

Coleta e análise de dados

Os dados para a avaliação de sustentabilidade do projeto PISACOOP-Catuguiriguaçu foram obtidos a partir de análise de documentos relativos ao projeto, visitas técnicas a propriedades rurais e entrevistas semiestruturadas com apoio de roteiro base (Apêndice A e B). Estas ações foram concretizadas junto aos distintos segmentos envolvidos no desenho e implantação do programa no período compreendido entre fevereiro de 2015 e julho 2016.

Foram realizadas entrevistas com todos os agricultores beneficiários do projeto (n=56), sendo 88% destes vinculados a produção leiteira e 12% à produção de gado de corte. Estes atores foram questionados quanto ao nível de participação nas etapas de concepção e aceitabilidade do projeto e da

expectativa de mudanças em sua propriedade e na geração de renda (Apêndice A). Além dos agricultores beneficiários, todos os técnicos e gestores envolvidos do projeto foram consultados (n=92). Diretor Nacional do Programa PISACOOP (1); Auditor interno do MAPA (1); Secretário Municipal de Agricultura (SMA - 28); Consultores Técnicos do projeto PISACOOP (4), Agentes financeiros (2 - Banco do Brasil e Cresol /Caixa Econômica Federal) (Apêndice B). As respostas obtidas foram classificadas em três níveis: Alto, Médio e Baixo. A definição destes graus levou em consideração os níveis de atendimento das demandas supracitadas (Apêndices A e B).

2.2 RESULTADOS

De maneira geral, o programa PISACOOP obteve 64% de escores altos. 10% de escore médio e 36% de escore baixo, frente aos indicadores utilizados para avaliação junto aos agricultores beneficiários deste programa (Tabela 2.1).

A maioria dos beneficiários (85%) demonstrou ser apto à adoção das práticas preconizadas pelo PISACOOP (Tabela 2.1). Igualmente, o programa apresentou alta aceitabilidade por parte dos agricultores. Diferentemente de outros programas anteriormente implantados nestes territórios, o PISACOOP não demandou obrigatoriedade na obtenção de bens e insumos à produção além daqueles comumente adquiridos pelos agricultores. Este foi um elemento muito favorável na sua aceitabilidade pelos beneficiários. Adicionalmente, registrou-se que 85% dos agricultores experimentaram o fenômeno de aumento de renda, após a implantação das práticas preconizadas pelo PISACOOP. Os indicadores inerentes ao acesso viário às propriedades e à água necessária as atividades produtivas não foram identificados como limitantes à efetivação das atividades agropecuárias em nenhuma das propriedades consultadas.

No entanto, a mecanização agrícola se apresentou como fator limitante aos agricultores. Apenas 30% dos agricultores participantes do projeto PISACOOP possuíam maquinário necessário à execução das práticas agropecuárias tradicionalmente desenvolvidas em suas propriedades. Os demais agricultores acessam tais recursos por meio de empréstimo junto às associações de produtores locais.

O relevo também foi identificado como um fator adverso ao desenvolvimento das atividades agropecuárias em aproximadamente 85% das propriedades. Outro fator limitante foi a disponibilidade de mão de obra. Apenas 20% dos agricultores entrevistados assumiu possuir mão de obra suficiente à execução e / ou ampliação das suas atividades agrícolas. Entretanto, 75% dos agricultores entrevistados enfatizaram, como um dos resultados do PISACOOP, a redução do número de horas/trabalhador dedicadas à execução das atividades agropecuárias.

Tabela 2.1 Avaliação do programa PISACOOP no território Cantuquiriguaçu e Paraná – centro, segundo entrevistas a agricultores beneficiários, 2016.

Indicadores - beneficiários (n=56)	**Escore**	**Escore**	**Escore**
a) Nível de conhecimento do programa (objetivos, metas, duração, etc.).	Baixo 10%	Médio 30%	Alto 60%
b) Participação em alguma etapa de concepção e delineamento do Programa;	Baixo 100%	Médio 0%	Alto 0%
c) Aceitabilidade do programa e da respectiva necessidade de mudanças em sua propriedade	Baixo 5%	Médio 10%	Alto 85%
d) Perfil da propriedade	**Escore**	**Escore**	**Escore**
I. Disponibilidade de mão de obra	Baixo 70%	Médio 10%	Alto 20%
II. Disponibilidade de mecanização	Baixo. 60%	Médio 10%	Alto 30%
e) Aptidão territorial	**Escore**	**Escore**	**Escore**
I. Relevo	Baixo. 85%	Médio. 10%	Alto. 5%
II. Clima	Baixo. 0%	Médio. 0%	Alto. 100%
III. Disponibilidade de água	Baixo. 0%	Médio. 0%	Alto. 100%
IV. Acesso viário	Baixo. 10%	Médio. 20%	Alto. 70%
f) Expectativas	**Escore**	**Escore**	**Escore**
I. Mudança na propriedade	Baixo. 20%	Médio. 55%	Alto. 25%
II. Geração de renda	Baixo 5%	Médio 10%	Alto 85%

No que se refere ao desempenho do arranjo institucional que amparava o PISACOOP, evidenciou-se 20% de escore alto, 60 % de médio e 20% de baixo (Tabela 2.2).

Tabela 2.2: Avaliação do programa PISACOOP no território Cantuquiriguaçu e Paraná – centro, segundo entrevistas a representantes de entidades proponentes e executoras (ambiente institucional) do programa PISACOOP no Território Cantuquiriguaçu e Paraná – Centro, 2016.

Ambiente institucional (n=35)	**Escore**	**Escore**	**Escore**
Ações de promoção participativa dos beneficiários e de outras instituições no delineamento do Programa.	Baixo	Médio. 100%	Alto.
Ações de divulgação e promoção continuadas do programa junto a potenciais beneficiários.	Baixo	Médio. 100%	Alto.
Processo de formação de multiplicadores locais.	Baixo	Médio. 100%	Alto.
Processo de monitoramento e avaliação de impactos no território.	Baixo	Médio.	Alto. 100%
Possibilidade de suporte financeiro às ações preconizadas pelo programa.	Baixo 100%	Médio.	Alto.

No que se refere a promoção participativa, aproximadamente 60% dos beneficiários foram capazes de descrever claramente o escopo do projeto, bem como suas etapas e tempo de permanência no território. Entretanto, nenhuma participação dos agricultores durante as fases de desenho do projeto base foi identificada, rebaixando a qualificação do projeto PISACOOP neste item.

Ações divulgação e promoção do projeto junto a potenciais beneficiários foram observadas, determinando avaliação positiva neste quesito. No entanto, não foram registradas práticas formais neste âmbito. Ditas atividades foram materializadas por meio de dois seminários técnicos anuais realizados aleatoriamente nos diferentes municípios do território Cantuquiriguaçu e Paraná Centro.

Observou-se que a instituição responsável pelos serviços de ATER promoveu apenas práticas informais no que concerne formação de multiplicadores locais. Não havia um programa devidamente estruturado ou agenda específica para este quesito.

Atividades de monitoramento do desempenho e implantação temporal das ações propostas pelo PISACOOP foram observadas. Neste quesito, o programa obteve “Alto” escore, uma vez que ações desta natureza foram realizadas durante todos os meses do seu ciclo de vida.

Quanto às instituições de credito rural localizadas no território estudado, nenhuma demonstrou conhecimento sobre a existência do projeto PISACOOP. Este cenário qualifica o programa como “Baixo” neste tema avaliado.

2.3 DISCUSSÃO

A alta qualidade e o caráter participativo dos serviços de assistência técnica e extensão rural (ATER) junto ao PISACOOP foram sublinhados pelo conjunto dos agricultores e Secretários Municipais de Agricultura consultados.

Esta característica se sobressaiu frente aos demais pontos observados, contrapondo os caminhos percorridos pela assistência técnica e a extensão rural no Estado do Paraná que historicamente compreendiam uma mão única de comunicação, não havendo o compartilhamento de informações e experiências entre as partes (MEDEIROS e BORGES, 2007).

Comumente, proposições referentes às mudanças na propriedade rural (reorganização e operação das atividades agropecuárias) estiveram presentes nos programas e projetos de caráter público e privado, sendo ignorados os conhecimentos tradicionais dos sujeitos locais, sobretudo dos agricultores familiares (SCHNEIDER, 2012).

Desta forma, iniciativas engajadas na promoção dos processos de desenvolvimento rural que prezam pela equidade da participação das partes interessadas, devem considerar e internalizar a importância destas particularidades no seu escopo de ações.

Quanto à mudança na renda familiar, foi percebida que a grande maioria dos agricultores participantes do programa PISACOOP superou suas expectativas prévias em relação à melhora / aumento da produtividade agropecuária. A produção media mensal de leite produzida pelos beneficiários do PISACOOP passou de 5.341 litros, ao inicio do programa (ano de 2015), para 8.472 litros na data referente a esta pesquisa, representando um incremento produtivo de 58,6% (SIA, 2016).

A redução média do consumo de silagem e ração pelo rebanho leiteiro foi de 35,6% e 47,5% respectivamente (SIA, 2016), contribuindo para a diminuição do custo médio da produção do leite em 22,2%. Este fato é

aparentemente basilar à sustentabilidade de um projeto. Sobre este aspecto Heldman (2006) opina que uma iniciativa obterá sucesso se lograr atender às expectativas das partes interessadas do projeto.

Tais ganhos de produção e produtividade foram possivelmente ocasionados pela aptidão dos agricultores às práticas de SIPA e demais atividades de agricultura de conservação e das boas práticas agropecuárias propostas pelo PISACOOP. Explorar e promover estas aptidões e praticas, aparentemente contribuiu para o alcance dos objetivos propostos por iniciativas que visam promover os processos de desenvolvimento agrícola e rural.

Sob o prisma das características limitantes identificadas, o programa carece de ações (formais) de promoção da sucessão familiar nos territórios participantes. Este fato é preponderante à sua sustentabilidade uma vez que o território converge com a tendência nacional no que diz respeito à sucessão familiar não consolidada e escassez de mão de obra (IPARDES, 2014).

Projetos de desenvolvimento rural inseridos em territórios que experimentam o envelhecimento populacional devem estar aptos a promover a gestão eficiente da mão de obra disponível (FAO, 2016), porquanto, os padrões demográficos do campo e a idade dos agricultores são fatores importantes à execução das atividades rurais e promoção da multifuncionalidade do campo (SOFI, 2014).

Sobre a importância deste tema, o Ministério de Desenvolvimento Social e Combate à Fome (BRASIL, 2015), assume que a agricultura familiar é a responsável pela produção de 70% dos alimentos, ocupa 74% da mão de obra do campo e é responsável por 10% do Produto Interno Bruto do país.

Desta forma, num cenário futuro, as implicações da não concretização da sucessão familiar no território de inserção do PISACOOP poderão ser diversas e quando considerado um cenário extremo e limitante, poderão ameaçar a segurança alimentar daquele território, dada a imprescindível contribuição dos agricultores à geração de alimentos em nível local (BUCCO, 2015).

Em relação à participação social dos beneficiários nas distintas fases do programa, foi identificado que o conjunto de agricultores entrevistados não participou do processo de escolha das propriedades. Tampouco, tal processo foi identificado nos documentos do programa durante a pesquisa.

Schneider (2010) afirma que a participação da sociedade no desenho de programas de desenvolvimento rural ainda é algo muito incipiente no Brasil, o que vem contribuindo para a manutenção dos baixos níveis de sustentabilidade destas ações.

Estes aspectos ameaçam a representatividade do programa PISACOOP, pois a definição do publico alvo e a promoção da sua participação em iniciativas desta natureza, determinará o tipo de impacto e qualidade destes nos processos de promoção do desenvolvimento local.

Neste aspecto, se faz imperiosa a adoção de ferramentas de diagnóstico consagradas, tais como o Diagnóstico Rural Participativo (DRP), Árvore de Problemas, Matriz FOFA, etc., na fase de escolha do publico alvo, bem como a inserção de mecanismos para sua participação efetiva, formalmente mensurável e isonômica.

A premissa básica do PISACOOP versa sobre a formação de multiplicadores em nível local; contudo, isso ocorreu informalmente caracterizando a ausência de procedimentos específicos e descritos no documento base do programa.

Este princípio é fundamental ao cumprimento dos objetivos inerentes a promoção do desenvolvimento rural uma vez que a capacidade de persistência dos conhecimentos técnicos nos municípios participantes no projeto e sua extensão a outros territórios residem na formação de multiplicadores locais. Sob a ótica atinente à importância destes atores, instituições como o Serviço Brasileiro de Apoio a Pequenas Empresas (SEBRAE, 2014), considera sua atuação fundamental à articulação das ações públicas para a promoção do desenvolvimento local e territorial.

Quanto aos mecanismos financeiros necessários a materialização das inovações propostas pelo programa, foi observada a disponibilidade de linha de crédito específica à implantação e manutenção das ações preconizadas pelo PISACOOP nas instituições financeiras locais. Todavia, a inexistência de técnico atuante no programa, apto ao esclarecimento das características desta linha de credito, bem como o desconhecimento sobre a existência do programa PISACOOP, por parte das instituições bancárias locais, são consideradas ameaças à sustentabilidade do projeto.

A dificuldade de acesso ao crédito para o investimento em SIPA tem sido sublinhada por muitos pesquisadores como um grande entrave à sua adoção (EMBRAPA, 2014). Tal barreira é caracterizada pela falta de conhecimento dos agentes bancários, pelo pouco interesse dos bancos em financiar este tipo de crédito, pela alta burocracia e complicação, pelo excesso de exigências na comprovação do custeio e pela dificuldade de contratar projetista qualificado (GASPARINI, 2017).

Dada circunstância ameaça a sustentabilidade de iniciativas que propõe mudanças do cenário rural, sobretudo em estratégias implantadas em territórios portadores de baixo índice de desenvolvimento humano (IDH) ou naqueles onde os agricultores detêm baixo poder de investimento na aquisição dos insumos necessários à adequação das atividades agropecuárias exigidas pelo mercado (ERND, 2015).

Nesta ótica, o cooperativismo se apresenta como modelo de organização social reconhecidamente eficaz no combate às barreiras procedentes de crises econômicas (DE OLIVEIRA, 2013). Portanto, projetos que subsidiam e concretizam ações desta natureza, tendem a ser mais robustos no que se refere à estabilidade e coesão dos seus beneficiários nestes cenários.

O não cumprimento do compromisso assumido pelos gestores do programa PISACOOP, no que tange à promoção do cooperativismo entre os beneficiários, pode implicar na ameaça a existente coesão social do grupo de agricultores participantes no PISACOOP (VEIGA, 2014).

O ambiente político institucional identificado foi visivelmente favorável à execução do PISACOOP. As Secretarias Municipais de Agricultura (SMA) apoiaram a implantação do programa no território do Cantuquiriguaçu e demais municípios participantes do Território Paraná – Centro em diferentes níveis.

Foi percebido que nos municípios onde o PISACOOP obteve maiores êxitos (aceitação pelos beneficiários, aumento da produção e produtividade agropecuária), as entidades políticas locais (SMA), agenciaram a participação dos agricultores nos eventos promovidos pelo projeto.

Recomenda se às iniciativas afins ao PISACOOP, a internalização e consequente materialidade de mecanismos promotores da participação das entidades políticas locais (pertencentes ao seu arranjo institucional), no escopo

de ações intrínsecas a tais iniciativas. Por meio de mecanismos constatáveis, torna se facilitado o processo de averiguação dos níveis de comprometimento e participação destes entes nas estratégias de desenvolvimento rural, o que facilita, igualmente, tecer observações e relações de causa e efeito dos resultados alcançados pelos projetos e programas desta natureza.

O fato dos SIPA proporcionarem benefícios econômicos potenciais nas economias de escopo, nos efeitos de redução de risco pela diversificação da produção e na criação de um ambiente com maior estabilidade econômica (BEHLING et al., 2014; HIRAKURI et al., 2012; SILVA, 2014; ZAFALON, 2015), se torna um atrativo aos promotores deste modelo de produção agropecuária.

Contudo, a dependência de programas governamentais em orçamentos públicos, como é o caso do PISACOOP, confere instabilidade a estas estratégias enquanto potencial instrumento de promoção dos processos de desenvolvimento rural.

Sobre este fator limitante, é sublinhada a necessidade de transformação do apoio institucional das prefeituras municipais beneficiadas pelo PISACOOP, em negociação junto às esferas do poder publico e privado responsáveis pela gestão de recursos financeiros direcionados à agropecuária.

Como alternativa a este anseio, dito apoio dar-se-à por meio da concertação entre as partes interessadas, onde as evidências que justificam o investimento de recursos públicos / privados em SIPA, sejam comunicadas eficientemente às entidades convenentes dos recursos.

Finalmente, no que se refere aos mecanismos de avaliação e monitoramento de projeto, a ausência de documento base organizado dificultou sua avaliação em profundidade. Ocorreram avaliações, em regime mensal, sobre o desempenho do PISACOOP e tais ações foram desenvolvidas eficientemente pela empresa privada responsável pela execução do projeto.

Contudo, as informações aqui coletadas provem dos responsáveis pela concepção do programa e de documentos desestruturados disponibilizados pelo MAPA, tornando abstrusa a realização de processos de auditoria externa adequada e consequente confrontação entre seu desempenho em relação a sua missão prévia.

Dada característica possui uma implicação elementar a qualquer projeto que se proponha a promover os processos de desenvolvimento rural,

porquanto, ameaça sua existência como política pública (ALVES, 2008), uma vez que sua missão e contrapartida institucional oscilam em meio aos diferentes enfoques dos seus idealizadores (FAVARETO, 2007).

Estratégias com estas características têm alta probabilidade em ficar a mercê do ambiente político e tendências ao qual este se insere e não de um documento formal suprapartidário que o justifique e permita sua multiplicação e avaliação.

2.4 CONSIDERAÇÕES FINAIS

Evidenciou se que as mudanças ocorridas nas propriedades participantes do programa, aparentemente atenderam as expectativas do seu publico alvo. As práticas agronômicas inerentes aos SIPA adotadas nas propriedades foram definidas pelos agricultores beneficiários do projeto, revelando seu caráter participativo durante esta fase.

Ressalta-se que a instituição proponente do projeto carece de procedimentos metodológicos formais pertinentes ao desenho, metodologia e ações implantadas, elementos essenciais à sustentabilidade de projetos.

Os resultados obtidos pela adoção de SIPA como pilar do projeto piloto no território do Cantuquiriguaçu e Paraná Centro, associados à premissa da manutenção dos aspectos positivos do projeto e da materialização das mudanças aqui identificadas, corroboram para sua extensão a outros territórios.

Nesta circunstância, os SIPA podem ser reconhecidos como um potencial mecanismo promotor dos processos de desenvolvimento do meio rural.

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APÊNDICE A

Questões aplicadas aos agricultores participantes do programa PISACOOP no Território Cantuquiriguaçu e Paraná Centro. (Brasil, 2016).

Capacidade dos potenciais beneficiários e atendimento das suas expectativas.
Nível de conhecimento do programa
Baixo. Desconhece as etapas do programa, suas metas e duração. Médio. Conhece parcialmente o programa. É capaz de descrever ao menos três das seguintes etapas do programa: - O objetivo do programa. - O processo de escolha das propriedades participantes. - O regime de visitas e assistência técnica proporcionada pelo programa. - O tempo de duração do programa. - Os processos de monitoramento e avaliação do programa. Alto. Conhece todas as etapas do programa descritas acima.
Participação no delineamento do programa.
Baixo. Não participou em nenhuma etapa do delineamento do programa. Médio. Participou em uma ou mais etapas do delineamento do programa. Alto. Participou em todas as etapas do delineamento do programa acima descritas.
Aceitabilidade das práticas propostas pelo programa.
Baixo. Desaprovou o programa. Médio. Aceitabilidade parcial do programa. Conhece o programa, contudo, possui ressalvas quanto sua efetividade. Alto. Alta aceitabilidade do programa. Aprova e recomenda aos demais agricultores a participação no programa.
Perfil da propriedade – Mão de Obra e acesso à maquinaria agrícola.
Baixo. Baixa disponibilidade de mão de obra necessária à execução das atividades produtivas. Médio. Possui limitada mão de obra a execução das atividades agrícolas. Necessita contratar trabalhadores externos à propriedade. Alto. Possui mão de obra suficiente a execução das atividades agrícolas.
Baixo. Não possui maquinário suficiente as atividades agrícolas. Médio. Possui limitado acesso ao maquinário. Necessita obter equipamentos agrícolas de fora da propriedade. Alto. Possui acesso à mecanização agrícola suficiente as atividades agrícolas.
Aptidão territorial- Relevo, Clima, Água e Acesso viário.
Baixo. Relevo forte ondulado. Em atendimento à definição procedente da classificação da Sociedade Brasileira de Ciências do Solo (SBCS). Médio. Relevo levemente ondulado. Em atendimento à definição procedente da classificação da Sociedade Brasileira de Ciências do Solo (SBCS). Alto. Relevo sem restrições à mecanização agrícola.
Baixo. Clima limitante as práticas agrícolas. Médio. Clima parcialmente limitante as práticas agrícolas. Demanda irrigação à execução das atividades agropecuárias. Alto. Clima não restringe práticas agropecuárias.
Baixo. Não possui acesso a água. Médio. Possui acesso limitado a água. Demanda irrigação à execução das atividades agropecuárias. Alto. Não possui restrições de acesso a água.

Baixo. Vias de acesso em condições limitantes. Impossibilidade de escoamento da produção quando da ocorrência de eventos climáticos extremos. Médio. Vias de acesso com limitações parciais. Alto. Vias de acesso em condições não restritivas.
Expectativas – Incremento de renda procedente da adoção das ações propostas pelo programa
Baixo. Baixa contribuição do programa ao incremento de renda da propriedade. Médio. Media contribuição do programa ao incremento de renda da propriedade. Alto. Alta contribuição do programa ao incremento de renda da propriedade.

APÊNDICE B

Questões aplicadas às entidades proponentes e executoras (ambiente institucional) do programa PISACOOP no Território Cantuquiriguaçu e Paraná Centro. (Brasil, 2016).

Papel e Influência do Ambiente Institucional
Promoção da participação social das partes interessadas.
Baixo. Não promoveu a participação das partes interessadas. Médio. Promoveu parcialmente a participação das partes interessadas – ao menos duas das seguintes atividades foram promovidas ao longo do ciclo de vida do projeto: • Definição das práticas agropecuárias adotadas nas propriedades participantes do programa. • Participação no processo de escolha das propriedades participantes. • Definição dos entes participantes do arranjo institucional do programa. • Avaliação dos agentes de ATER. • Participação nos processos de avaliação e monitoramento do programa. Alto. Promoveu a participação das partes interessadas em todas as fases definidas acima.
Ações de divulgação
Baixo. Nenhuma ação de divulgação e promoção do programa foi identificada. Médio. Algumas ações de divulgação e promoção do programa foram identificadas. Ao menos duas ações de divulgação e promoção do programa à comunidade externa foram realizadas anualmente. Alto. Ações de divulgação e promoção do programa foram realizadas. Mais que duas ações de divulgação em ao menos um dos meios de comunicação (TV, Radio, Jornal local, etc.) foram realizadas anualmente, ademais daquelas promovidas entre os agricultores participantes e comunidade externa.
Promoção de ações para a formação de multiplicadores locais.
Baixo. Nenhuma ação de capacitação para a formação de multiplicadores locais foi identificada. Médio. Ao menos uma ação de capacitação para a formação de multiplicadores locais foi identificada anualmente. Alta. Mais de duas ações de capacitação para a formação de multiplicadores locais foram identificadas anualmente.
Monitoramento dos resultados do programa.
Baixo. Nenhum mecanismo de monitoramento identificado. Médio. Ao menos um mecanismo de monitoramento identificado anualmente, ademais daqueles inerentes à prestação de contas por parte da entidade proponente do projeto. Alto. Monitoramento realizado em todas as etapas do programa.
Possibilidade de suporte financeiro às ações preconizadas pelo programa
Baixo. Nenhum suporte financeiro ao programa foi identificado. Nenhuma linha de crédito especifica foi identificada. Médio. Ao menos uma linha de crédito agrícola apta ao suporte à adoção das práticas preconizadas pelo programa. Alto. Mais que duas linhas de crédito agrícola aptas ao suporte à adoção das práticas preconizadas pelo programa.

3 IS ICLS A SECURE ALTERNATIVE TO ACHIEVE UNITED NATIONS SDG NUMBER 2 WHILE PROMOTING SUSTAINABLE AGRICULTURE IN THE CASE OF SMALLHOLDERS? THE CASE OF THE PISA PROGRAM IN BRAZIL.

Integrated crop livestock systems (ICLS) play a critical role on promoting food security to smallholder farmers (SF) in developing countries. Many researchers asserted that complementarities and synergies between crops and livestock can improve nutrient cycling and delivery of ecosystem services in agricultural systems. However, there is a lack of studies associating the capability of ICLS on promoting sustainable agriculture in the case of smallholder farmers. Given the essentiality of SF regarding the fulfilment of sustainable agriculture and food security worldwide, the United Nations launched a set of targets that calls on supporting this typology of farmers to accomplish a Sustainable Development Goal 2 (SDG2) which aspires to ending hunger, achieve food security, improved nutrition and promote sustainable agriculture. In this perspective, the current research consists in the verification of the ICLS ability to meet the UN SDG02 when implemented in smallholder farms. For the accomplishment of this study, the targets related to SDG02 were cross-referenced with the pertinent Sustainability Assessment of Food and Agriculture Systems Smallholders Indicators (SAFA Smallholders APP). The information collection took place in 2017 in 407 rural properties that were part of a public private pro ICLS program in 22 municipalities of Rio Grande do Sul State, southern Brazil. Based the scope of the employed sustainability assessment tool, 86% of the indicators achieved the highest score possible, 4 indicators acquired “Unacceptable” qualification and 7 indicators obtained “Moderate” marks demanding adequacies to achieve the satisfactory levels stated on SAFA Smallholder tool. In the observed circumstances, the evaluated ICLS initiative provided evidences that support this agricultural model as an alternative to the accomplishment of UN SDG 2 in the case of family farmers. The results are presented and discussed.

Key words: Food security, family farming, mixed crop livestock systems

3.1 INTRODUCTION

Agricultural development is fundamentally linked to economic growth that directly benefits the poor fractions of rural society (MAYER, 2016). It is estimated that agriculture development is about two to four times more effective in raising incomes among the poorest than growth from any sector and up to 11 times more effective in sub-Saharan Africa (WORLD BANK, 2017). Investing in the agricultural sector can address not only hunger and malnutrition but also other challenges including poverty, water and energy use climate change, unsustainable production and consumption (FARMING FIRST, 2015).

Playing an elemental role on the sustainability of food and agricultural sector, smallholder farmers are responsible of managing the majority of the world's agricultural land and produce most of the world's food (SOFI, 2017). They supply about 70 per cent of Africa's total food requirements and provide around 80 per cent of the food consumed in both Asia and sub-Saharan Africa (FAO, 2011). As stated by the Food and Agriculture Organization of United Nation (FAO, 2014), society needs smallholders to ensure global food security, to care for and protect the natural environment and to end poverty, undernourishment and malnutrition.

As an answer to the challenges of ending hunger, achieve food security and improved nutrition while promoting sustainable agriculture (UN, 2015), FAO has been supporting many agricultural models of food production as the integration of crop and livestock systems (ICLS)[1] and its varying typologies (FAO, 2010). To have a glance on ICLS international representativeness, these systems are extant in 25 million km2 (BELL and MOORE, 2012) and accounts for approximately 50% of world food production - 65% of cattle, 75% of milk and 55% of lambs in developing countries (HERRERO et al., 2010). The integration of crop livestock systems promotes diversity in agriculture systems, driving the productivity-environment trade-off. This approach diversifies landscape mosaics

[1] *Integration can be on-farm as well as on an area-wide basis that may involve some specialization. Successful integration involves an intentional integration that reflects a synergistic relationship among the components (the whole is greater than the sum of the parts) of crops, livestock and/or trees and that this synergistic relationship when appropriately managed results in enhanced social (including community), economic and environmental sustainability and improves the livelihoods of those farmers who manage them (FAO, 2010).*

enhancing biodiversity, providing both high productivity and ecosystem services (LEMAIRE et. al., 2014).

In Brazil, the ICLS started as a punctual and scattered process at the end of the 19th century, mainly in the southern temperate subtropics, particularly in the classical arrangement of flooded rice fields and native grasslands in Rio Grande do Sul State (MORAES et al, 2014). In due course, this model of agriculture has evolved into a national integrated agricultural production program known as PISA (MAPA, 2014). Thus far, PISA program has been implemented in Paraná, Santa Catarina and Rio Grande do Sul States, encompassing ~1800 small stakeholders over 75 municipalities, consisting mainly of small dairy farmers (SIA, 2017).

Recently, PISA program had its performance against mission evaluated under the scope of SAFA tool[1] instrument designed by FAO to evaluate the agricultural sustainability along the food sector. PISA has reached high levels of sustainability and recognition as an alternative towards sustainable agricultural intensification to farmers as recommended by FAO on its pertaining document (BONATTO ET AL. INÉD.).

However, this agricultural model has not been evaluated in terms of its effectiveness on the subject of promoting sustainable agriculture to smallholder farmers. Moreover, rural and agricultural development initiatives, like the PISA program, are on the odd occasion evaluated with the aim of identifying their potential contributions towards the promotion of United Nations Sustainable Development Goal 2 which is associated to the backing up of sustainable agriculture (DE OLDE, 2017).

Seeking to identify the ability of ICLS as an alternative that contributes with the achievement of United Nations Sustainable Development Goal 2[2], while

[1] The Sustainability Assessment of Food and Agriculture Systems (*SAFA) offers a holistic framework that encompasses all aspects of sustainable cropping, livestock husbandry, fisheries, aquaculture and forestry production, postharvest, processing, distribution and marketing. It builds mainly on existing sustainability schemes, creating opportunities for enterprises to use existing data and combining efforts with other tools and sustainability initiatives. SAFA allows a fair playing field for all by presenting a framework that is adaptable to all contexts and sizes of operations (FAO, 2013). For detailed information, see: http://www.fao.org/nr/sustainability/sustainability-assessments-safa/en/*

[2] *The SDG is a plan that seeks to strengthen universal development for both developed and developing countries until 2030. It adopts people-centred and planet-sensitive strategies and it aims to be measurable to drive action and track progress. The eradication of poverty in all its forms and dimensions, including extreme poverty plays a central point in such initiative – SDG number 2: "End hunger, achieve food security, improved nutrition and promote sustainable agriculture" (UN, 2015).*

promoting sustainable agriculture in the case of smallholder farmers, an analysis of PISA program has been performed.

3.2 MATERIALS AND METHODS

The PISA project analysis was performed using primary data from project document material, individual interviews and field visits. The interviews were targeted to cover different levels of PISA program, from its designing phase to stages of its implementation. In total, the PISA general state coordinator was interviewed (n=1), the Rural Advisory Services (RAS) technicians (n=6), and the program beneficiaries (n=407) from the regions where the program was implemented (22 municipalities from Rio Grande do Sul State). Program beneficiaries were identified as being at the ending of the 3-year PISA contract.

All interviewed beneficiaries were identified as ICLS farmers dealing with cattle and mixed cropping agriculture, with 90 % categorized as dairy farm, 10% as meat producers as well as 100% considered to be family farmers (smallholder farmers). The entire cohort were visited and interviewed (n= 407). Field visits covered a broad range of property types (=17,5±5 ha, minimum size= 3 ha, maximum size= 50 ha).

The analysis was based on integration of SAFA Smallholders indicators (FAO, 2016) (Annex 3) and the targets of Sustainable Development Goal 2 (UN, 2015) (Annex 1). Considering both documents, the selection of the SAFA Smallholders App.[1] indicators has considered its capability of meeting the demands of the Targets defined on United Nations SDG 2 (Annex 1). The data analysis was performed using the Sustainability Assessment of Food and Agriculture Systems Smallholders App. (SAFA, 2016) tool, employing the mobile SAFA application software version 2.2.402 following the directions described in SAFA Guidelines VERSION 3.0 (FAO, 2013). In total, the analysis

[1] *The SAFA Smallholders App (version 2.0.0) is an open source, freely-available and user-friendly software offered by FAO to implement the SAFA Guidelines (version 3.0) for the sustainability assessment of small-scale agriculture producers. The SAFA Smallholders App considers the potential lack of data, lack of time and capacity, as well as irrelevance of some global indicators for small-scale producers. The Guidelines adopted were condensed so that smallholders could measure the most critical aspects of what really matters for their own sustainability (FAO, 2016).*

included 44 default indicators, divided into 21 themes and 74 questions related to the four dimensions of sustainability (Table 3.1).

Table 3.1: United Nations SDG 02 targets and its associated SAFA Smallholders App. indicators applied on the analysis of the PISA program in Southern Brazil. 2017.

Targets of United Nations Sustainable Development Goal Number 2	**SAFA SMALLHOLDERS APP. tool related indicators and its pertaining questions**	
2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.	**Food Sovereignty** Question 90 & 92. **Wage level** Questions 99 & 100.	
2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.	**Food Sovereignty** Question 91. **Food Loss and Waste Reduction** Questions 64 & 65.	
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.	**Profitability** Questions: 9, 10, 11, 12, 13 & 14. **Capacity Development** Question 77. **Gender equality** Questions 84, 85, 86, 87 & 88. **Tenure rights** Questions 95 & 96. **Non-discrimination** Question 83. .	**Safety Nets** Questions 25, 26 & 27. **Product Diversification** Questions 15 & 16. **Stability of Market** Questions 17, 18 & 19. **Safety of Workplace, Operations and Facilities** Questions 69, 70, 71, 72, 73, 74, 75 & 76. **Liquidity** Questions 22, 23 & 24
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.	**Sustainability Management Plan** Questions 6, 7 & 8. **GHG Mitigation Practices** Questions 33 till 38. **Air Pollution Prevention Practices** Questions 39 & 40. **Soil Improvement Practices** Questions 41 & 42. **Nutrient Balance** Question 43. **Land Conservation and Rehabilitation Practices** Question 44. **Certified Products** Questions 30 & 31.	**Water Conservation Practices** Questions 55, 56 & 57. **Animal Health and Welfare** Questions 66, 67 & 68. **Energy Use/Energy consumption/Renewable energy** Questions 61, 62 & 63. **Hazardous Pesticides** Questions 45, 46, 47 & 48. **Water Pollution Prevention Practices** Question 58. **Renewable and Recycled Materials** Questions 59 & 60.
2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed.	**Ecosystem Diversity** Question 49. **Species Conservation Practices** Question 50, 51 & 52. **Saving Seeds and Breeds** Questions 53 & 54. **Indigenous knowledge** Questions 93 & 94.	

3.3 RESULTS

Considering the entire 74 SAFA indicator used on the PISA analysis, it was evidenced that 86% of them reached the highest score possible, regarding the achievement of UN SDG 2 targets.

The best PISA performance was related to the UN SDG 2 targets 2.1 and 2.2 (Figures 3.1 and 3.2).

The 2.1 target states that by 2030 its affiliated countries will be required to commit to end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round. The four selected indicators linked to Food Sovereignty (Right to choose production type and Meals availability) and Wage level (Living wage and Producers living wage) have accomplished “Good” scores under the metric defined by the employed methodology.

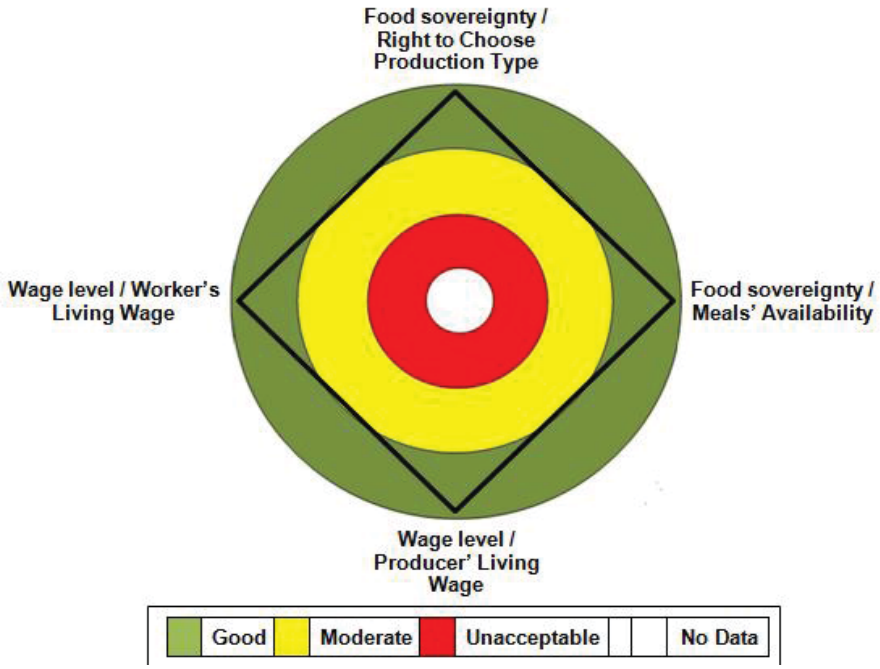

Figure 3.1: PISA performance related to UN SDG 2 target 2.1

The 2.2 target requires that by 2030 the associated nations entrusts to end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age and address the nutritional needs of adolescent girls, pregnant and lactating women

and older persons. The sustainability evaluation of ICLS initiative to smallholder farming (PISA project), has revealed that the indicators related to Food loss and waste reduction (Pre and post harvest food losses and Food loss reduction) have obtained “Good” scores. Following this pattern, the Food sovereignty (Access to culturally appropriate food) indicator has achieved “Good” qualification as well.

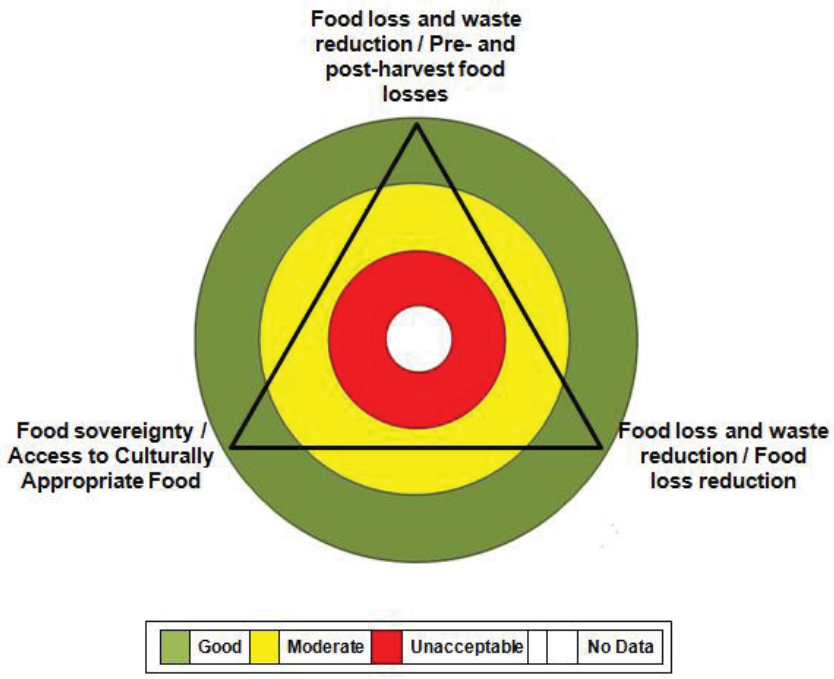

Figure 3.2: PISA performance related to UN SDG 2 target 2.2.

The PISA performance has not homogeneously acquired high scores considering the UN SDG 2 targets 2.3; 2.4 and 2.5.

The target 2.3, sets to its allied nations the objective of doubling up 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 by 2030.

With the exception of the indicators related to Workplace Safety and Health Provisions; Pesticide protective gear usage and Risk Avoidance whose have scored “Moderate”, the other 32 indicators evaluated have achieved “Good” classification (Figure 3.3, Table 3.2).

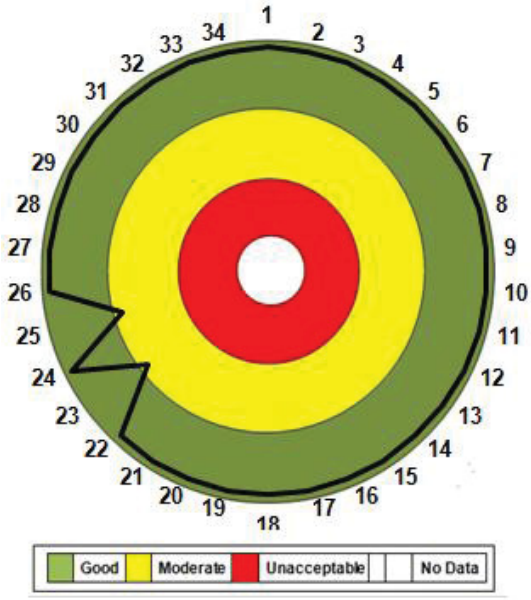

Figure 3.3: PISA performance related to UN SDG 2 target 2.3.

Table 3.2: PISA performance related to UN SDG 02 target 2.3

Question	Indicator	Score	Question	Indicator	Score
1	Profitability / Commercial Production	Green	18	Workplace safety and health provisions / Distance of medical care	Green
2	Profitability / Knowledge of Farm Revenue	Green	19	Workplace safety and health provisions / Affordability of medical care	Green
3	Profitability / Labour Costs	Green	20	Workplace safety and health provisions / Distance of safe drinking water	Green
4	Profitability / Fertilizers, pesticides and seeds and plant materials costs	Green	21	Workplace safety and health provisions / Access to sufficient and adequate water	Green
5	Profitability / Animal feed, veterinary and juvenile stock costs	Green	22	Workplace safety and health provisions / Pesticide application	Green
6	Profitability / Positive farm revenues	Green	23	Workplace safety and health provisions / Pesticide protective gear	Yellow
7	Product Diversification / Products and services on sale	Green	24	Workplace safety and health provisions / Farm Injuries	Green
8	Product Diversification / Value Addition	Green	25	Workplace safety and health provisions / Risk Avoidance	Yellow
9	Stability of Market / Diversity of buyers	Green	26	Capacity development / Training	Green
10	Stability of Market / Relationship with buyer(s)	Green	27	Non-Discrimination / Non-Discrimination	Green
11	Stability of Market / Choice of market	Green	28	Gender Equality	Green
12	Liquidity / Loan source	Green	29	Gender Equality / Men decisions	Green
13	Liquidity / Loan received	Green	30	Gender Equality / Women decisions	Green
14	Liquidity / Savings	Green	31	Gender Equality / Girls and boys education	Green
15	Safety Nets / Crop Insurance	Green	32	Gender Equality / Men and women training	Green
16	Safety Nets / Risk management plan	Green	33	Tenure rights / Tenure security	Green
17	Safety Nets / On-farm measures	Green	34	Tenure rights / Tenure constraints	Green

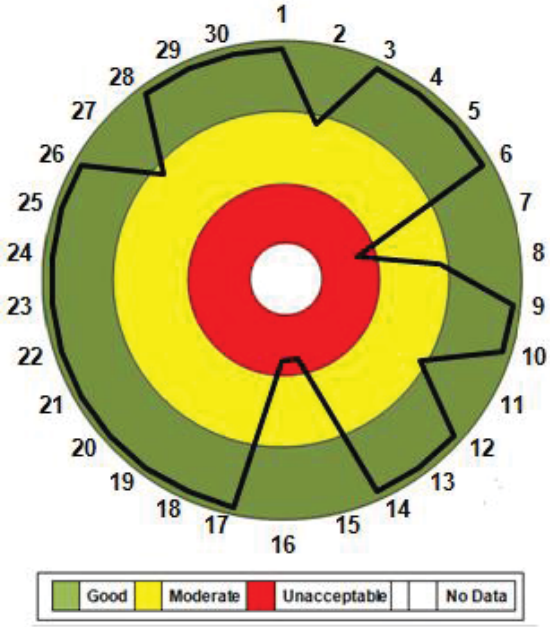

Figure 3.4: PISA performance related to UN SDG 2 target 2.4

Table 3.3: PISA performance related to UN SDG 2 target 2.4

Question	Indicator	Score	Question	Indicator	Score
1	Sustainability Management Plan / Management Plan	Green	16	Hazardous pesticides / Hazardous pesticides	Red
2	Sustainability Management Plan / Plan Success	Green	17	Hazardous pesticides / Pesticides label	Green
3	Sustainability Management Plan / Elements of Plan	Green	18	Hazardous pesticides / Pesticides mixing	Green
4	GHG mitigation practices / Tree Coverage	Green	19	Water conservation practices / Water use reduction	Green
5	GHG mitigation practices / Change in Tree Cover	Green	20	Water conservation practices / Irrigation	Green
6	GHG mitigation practices / Tillage Method	Green	21	Water conservation practices / Type of irrigation	Green
7	GHG mitigation practices / Ruminant Production	Red	22	Water pollution prevention practices / Water pollution	Green
8	GHG mitigation practices / Manure Management	Yellow	23	Renewable and recycled materials / Biomass management	Green
9	Air pollution prevention practices / Indoor air pollution	Green	24	Renewable and recycled materials / Materials recycling	Green
10	Air pollution prevention practices / Burning fields	Green	25	Energy use / Energy efficiency	Green
11	Soil improvement practices / Fertilizer type	Yellow	26	Energy use / Renewable energy source	Green
12	Soil improvement practices / Soil fertility	Green	27	Energy use / Renewable energy type	Yellow
13	Nutrient balance / Fertilizers Application	Green	28	Animal health and welfare / Access to veterinary care	Green
14	Land conservation. & rehab practices / Soil mgt	Green	29	Animal health and welfare / Livestock disease	Green
15	Water pollution prevention practices / Synthetic pesticides	Red	30	Animal health and welfare / Animal well-being	Green

The target 2.4 places the purpose of “ensuring sustainable food production systems and the implementation of resilient agricultural practices that increase productivity and production. As stated by UN, such approach ought to 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 by 2030” (UN, 2015).

The indicators related to GHG mitigation practices (Ruminant Production), Water pollution prevention practices (Synthetic pesticides), Hazardous pesticides (Hazardous pesticides use), have scored “Unacceptable”.

The linked GHG mitigation practices (Manure Management), Soil improvement practices (Fertilizer type) and Energy use (Renewable energy type) indicators have scored “Moderate” (Figure 3.4, Table 3.3)

The target 2.5 consigns the rationale of maintaining the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promoting access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed by 2020 (UN, 2015).

The indicator correlated to Indigenous knowledge has scored “Unacceptable”. The following 25% of the indicators related to the evaluated target have scored “Moderate”. The observed indicators are related to Species conservation practices / Crops disease management, Saving seeds and breeds / Sourcing seeds and breeds (Figure 3.5).

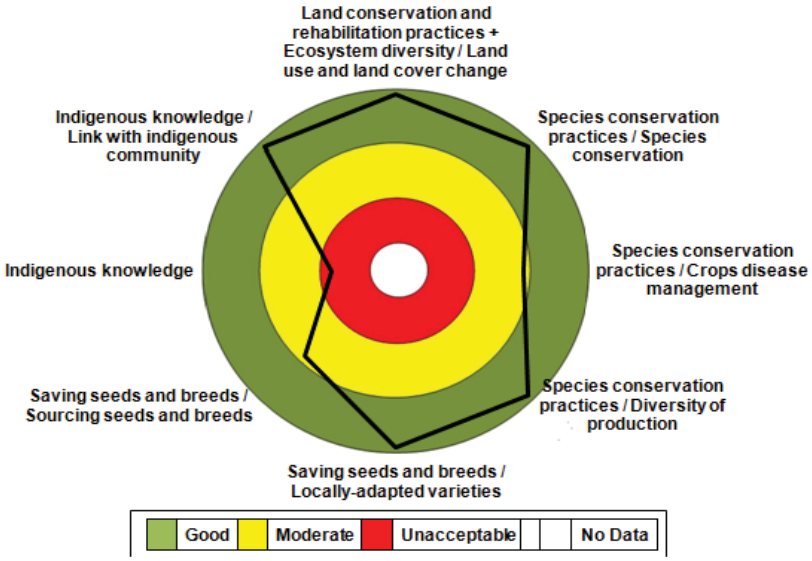

Figure 3.5: PISA performance of UN SDG 2 target 2.5

3.4 DISCUSSION

As stated by United Nations, achieving the SDG 02 goal will require better access to food and the widespread promotion of sustainable agriculture. This entails improving the productivity and incomes of small-scale farmers (smallholder farmers) by promoting equal access to land, technology and markets, sustainable food production systems and resilient agricultural practices (UN, 2015).

The performed sustainability appraisal of ICLS program has revealed high levels of convergence towards the promotion of SDG 02, but it has exposed some divergences concerning the PISA program potential contributions towards sustainable agriculture promotion in the case of smallholder farming. To clarify the identified bottlenecks, following we depicted the results obtained by the 2.3, 2.4 and 2.5 UN SDG 02 targets.

On what is related to hazardous pesticides indicators of the Environmental Integrity dimension (questions 46, 47, 48 and 51) the PISA program was neither able to demonstrate its commitments to promoting the minimization of environmental and health risks through the use of integrated pest management or organic techniques nor avoiding the use of red band pesticides. PISA program ought to internalize the subject related prerequisites

endorsed on SAFA guidelines if it aspires to be a reference on sustainability of food and agriculture production (RODGERS, 2009).

On what is regarded to Water pollution prevention practices (Synthetic pesticides, question 45) and Hazardous pesticides allied indicators (Hazardous pesticides use, question 46) PISA initiative have scored “Unacceptable”. Water pollution and chemical pesticides, are a risk to the health of humans, animals and the environment and the latter has the potential to cause severe or irreversible harm to human health and the environment (WHO, 2009). On this associated feature, PISA program should reassess its sustainable agriculture commitments by adopting more environmental sound stand point as its current way of working diverges from the current trends on environmental and human sustainability as it does not promotes a secure and safe production ambient to smallholder producers engaged on it.

On the topic of green house gas (GHG) emissions, SAFA Smallholders guidelines (2016) stands to the point that it does not encourage to accurately calculate these emissions of smallholder farmers, instead, it must focus on the most important practices for smallholders to reduce their GHG emissions as to support the usage of natural fertilizers and implementing manure management for livestock systems. As GHG mitigation practices are essential actions to fight climate change which can have many negative impacts on producers (SMITH et. al., 2008), it is advised to PISA program to formally subsidises and implement it within its cohort.

An important Environmental Integrity figure found during the evaluation is related to a specific SAFA Smallholders indicator disapproves any agricultural model that promotes Ruminant Production (question 37). Due the fact that PISA program arrangement is based on ruminant production (milk and meat production) it has acquired “Unacceptable” score for this indicator. The SAFA statement on it is opposed by the principles supported by Peyraud (2011) and Carvalho (2014) which have shown that ruminant animals may contribute as a catalyser of carbon sequestration from atmosphere under certain forage management approaches such as the “Rotatinuous” system. Under this circumstance, it may perhaps be revaluated aiming not down scoring this feature.

Excluding the indicators related to Workplace Safety and Health Provisions (Pesticide protective gear usage) and Workplace Safety and Health Provisions (Risk Avoidance) which obtained “Moderate”, the 32 remaining United Nations target 2.3 indicators evaluated achieved “Good” categorization. PISA mentors and managers ought to fulfil changes on those low scored indicators by adopting the procedures underlined at the pertinent section of SAFA guidelines, as they are essential to promote this target where human health is the uttermost and essential pre requisite to satisfy the other components enumerated by the mentioned UN target.

The monitoring of sustainability levels of this type of initiative is recommended as well as the socialization of the procedures needed (SAFA guidelines and FAO correlated documents) to accomplish acceptable performance levels for the “Moderate” and “Unacceptable” scored indicators.

The classification acquired by the chosen SAFA Smallholders appraised indicators (table 3.1) corroborates with the assumption that ICLS; when adopting the approach proposed by the PISA program scope of actions (MAPA, 2016) may perhaps contribute with the achievement of UNSDG 02, demanding feasible adjustments for it.

3.5 CONCLUSION

Throughout the performed ICLS evaluation (PISA program venture) elements were found that backing up the assumption that, under the circumstances perceived during the research activities, the cited agricultural approach can contribute via consummating the United nations sustainable development goal number 2 demanding a number of feasible actions to better fit the adaptations showcased on the SAFA Smallholder App pertaining guidelines.

Over the completion of this research, remains the aspiration for the dissemination of the illustrated initiative to smallholder farmers’ territories that faces incipient levels of sustainable agriculture and rural development as it can potentially play an important function on changing this provoking and protracted scenario.

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ANNEX 1 - United Nations SDG targets number 2 (UN, 2015).

2.1
By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.
2.2
By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.
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.
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.
2.5
By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed.

ANNEX 2: Sustainability assessment of food and agriculture systems (SAFA) internal subdivision. (FAO, 2013)

Dimensions	Themes	Subthemes
Good Governance	Corporate Ethics	Mission Statement Due Diligence.
	Accountability	Holistic Audits, Responsibility And Transparency.
	Participation	Stakeholder Dialogue, Grievance Procedures And Conflict Resolution.
	Rule Of Law	Legitimacy, Remedy, Restoration & Prevention Civic Responsibility And Resource Appropriation.
	Holistic Management	Sustainability Management Plan And Full-Cost Accounting.
Environmental integrity	Atmosphere	Greenhouse Gases And Air Quality
	Water	Water Withdrawal And Water Quality
	Land	Soil Quality And Land Degradation
	Biodiversity	Ecosystem Diversity, Species Diversity And Genetic Diversity
	Materials And Energy	Material Use, Energy Use And Waste Reduction & Disposal
	Animal Welfare	Animal Health And Freedom From Stress
Economic resilience	Investment	Internal Investment Community Investment Long-Ranging Investment and Profitability.
	Vulnerability	Stability of Production, Stability of Market, Stability of Supply
	Product Quality and Information	Liquidity and Risk Management.
		Food Safety, Food Quality and Product Information.
	Local Economy	Value Creation and Local Procurement
Social Well-being	Decent Livelihood	Quality of Life, Capacity Development and Fair Access to Means of Production.
	Fair Trading Practices	Responsible Buyers and Rights of Suppliers.
	Labour Rights	Employment Relations, Forced Labour, Child Labour and Freedom of Association and Right to Bargaining.
	Equity	Non Discrimination, Gender Equality and Support to Vulnerable People.
	Human Health and Safety	Workplace Safety and Health and Provisions Public Health.
	Cultural Diversity	Indigenous Knowledge and Food Sovereignty.

4 MEASURING AGRICULTURE SUSTAINABILITY – AN ANALYSIS OF A SUSTAINABILITY ASSESSMENT OF FOOD AND AGRICULTURE TOOL - SAFA/FAO SMALLHOLDERS APPLICATION

Abstract

SAFA Smallholders App is a sustainability evaluation tool designed by the Food and Agriculture Organization of United Nations (FAO) to provide means of assessing smallholder farmers considering that small-scale producers do not necessarily have the resources to engage into in depth and specific measurements. Given the innovative nature of this new tool and its wide use potential in the evaluation of sustainable production systems initiatives, an analysis of the application of SAFA Smallholders App is presented. The analysis derived from the experience gathered over its application measuring sustainability levels in 407 rural properties distributed in 7 municipalities of Rio Grande do Sul State, Southern Brazil. Over the analysis, it was found that SAFA Smallholders is a practical and feasible field evaluation tool; however, 4% of its indicators have presented adversities regarding the definition of classification patterns and indicator variables. Suggestions are presented with the aim of clarifying the author's stand point and unearth possible tool adaptations.

Key words: sustainability indicators, rural sustainable development analysis, sustainability evaluation.

4.1 INTRODUCTION

Equalizing food production with environmental conservation whilst promoting socioeconomic and cultural inclusion are key food security and ecological issues, posing a major challenge to the now and future human generations and the environment (LEMAIRE, 2014).

The global scenario has been demanding farmers to produce considerably larger amounts of food on land previously in production, hence, the existing disparity between potential yields and production sustainability for major crops and animal production illustrates that there is a significant capacity for augmenting production through sustained productivity growth manly on family farms (SOFI, 2014).

Alongside to those challenges and trends, society has been claiming for assurance and transparency regarding the methods adopted to produce food, feed, fibre and fodder. Labels have been designed and certifications schemes were compiled to best suit the aspects concerning the sustainability of food production.

However, the pathway related to sustainability evaluation of food systems under a holistic approach, employing multifaceted indicators, thus far struggles to be paved and frameworks for integrating information and data into an assessment of sustainability are currently lacking (GÓMEZ-LIMÓN and RIESGO, 2009; BINDERET al., 2012).

Given its importance, sustainability indicators of food chain are resources that can be used by farmers at the farm or field level to assess the effects of managerial changes (PANNELL and GLENN, 2000). Indicators are used to make a complex system understandable and to give meaningful information (BÉLANGER et al., 2012; SINGH et al., 2012).

Moreover, sustainability indicators are increasingly seen as important tools in assessing agricultural sustainability (VAN PASSEL and MEUL, 2012). In addition, it can help in communicating with the public (GÓMEZ LIMÓN and RIESGO, 2009) the impacts of agriculture practices implemented on a given site.

Converging to such tendencies and requirements the Food and Agriculture organization of United Nations (FAO) has designed the Smallholders

App (version 2.0.0), an open source to implement the sustainability assessment of food and agriculture systems (SAFA) Guidelines (version 3.0) for the sustainability assessment of small-scale agriculture producers (FAO, 2016)[1].

As state by FAO (2016), this instrument been thought to develop and adopt appropriate indicators and survey questions divided in four dimensions of sustainability (Social Wellbeing, Environmental Integrity, Economic Resilience and Good Governance). Those features reflect smallholders' size, practicality, scope and purpose of the assessment (i.e. better decision-making and farm management by acting upon identified weaknesses).

Considering that small-scale producers do not necessarily have the resources to engage into detailed measurements, SAFA performance scores were simplified to utilize three main thresholds for sustainability: good (green), limited (yellow) and unacceptable (red). This simplified rating is more appropriate given the scope of the SAFA Smallholders App assessment, as small-scale producers need to know where to focus for further improvement (FAO, 2016).

Though the SAFA Smallholders App follows the SAFA Guidelines (FAO, 2013), there are some changes in how the ratings of the overall performance scores are aggregated, as compared to the SAFA Tool (version 2.1.50).

While in the latter version of SAFA tool the highest aggregation level is at the Theme level, the SAFA Smallholders App aggregates scores at the Dimension level. The rating and weighting of the 100 answers of the survey determines the performance of the 44 Indicators and consequently, the scores of the 21 Themes and ultimately, of the four dimensions (Annex A).

For the most part of App questions, there are two types of questions: single and multiple choice answers. Some of these questions are used as trigger questions. Their answer will trigger the opening of the next question, according to a branching logic.

In the first and last sections of the survey, and at the end of each group of questions that is linked to one indicator there is space for explanations and comments. Therefore, SAFA operator can also find input fields for text,

[1] Detailed information on SAFA Smallholders App operation and features can be found at: http://www.fao.org/nr/sustainability/sustainability-assessments-safa/safa-app/en/ .

numbers, date and GPS reference. The device automatically offers the right input interface for the type of question (SAFA, 2016).

Concerning its international usage, the first version of SAFA tool has been tested in 23 SAFA pilots undertook in 19 different countries throughout the world (i.e. Bangladesh, Bolivia, Brazil, Canada, Costa Rica, Dominican Republic, Germany, Ireland, Italy, Nepal, New Zealand, Peru, Sao Tomé et Principe, Spain, Switzerland, Tanzania, Thailand, United Kingdom, United States of America). These pilots included crops, livestock, forestry, fisheries, wild harvests, cotton, bioenergy, tobacco and peat moss commodities and value chains, in small enterprises (FAO, 2013).

In Brazil it has been employed by the working group on integrated crop livestock systems research and extension called NITA (Centre for Technical Agricultural Innovation) from the federal University of Parana and GPEP (Group of Research on Pasture Ecology) from federal University of Rio Grande do Sul.

To date, SAFA Smallholders application has been employed up to 49 times (FAO, 2015), giving to it a demanding practices status as the proponent institution claims for suggestions and adaptations from its users.

In this context, given the ground-breaking nature of this new tool and its broad potential for use in the characterization of sustainable agriculture production enterprises, the results of a critical SAFA's application analysis in southern Brazil are presented. It aims to contribute to the permanent enhancement of this novel sustainability assessment instrument.

4.2 METHODOLOGY

The SAFA Smallholders App. analysis derived from the experience gathered over its application measuring sustainability levels in 407 rural properties distributed in 7 municipalities of Rio Grande do Sul State, Southern Brazil (March to December 2017).

Those properties encompassed dairy and grain producers that adopt integrated crop livestock systems as a model of production. The average property size was 18 hectares and the average herd size per property was 14 heads of milking cows.

The producers' average age was 55 years old and 45% of the consulted public was female.

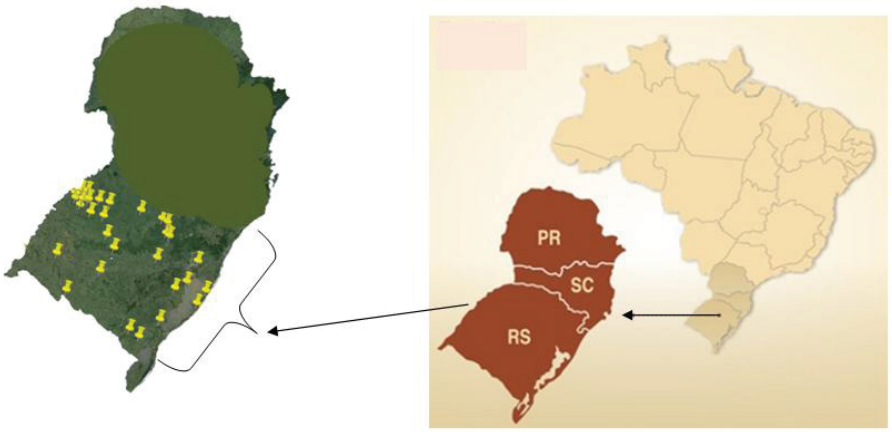

Figure 4.1: Location of PISA program cohort interviewed, Rio Grande do Sul State Brazil. 2017. Source: Landsat, 2017.

4.3 RESULTS AND DISCUSSION

SAFA smallholder application tool detains varies positive features. It is reasonably easy to operate presenting comprehensible results at real time to the entity assessed which can be understood as an advantage regarding the immediate communication of a given sustainability scenario under evaluation.

It adopts mainly up dated scientifically based indicators that clearly reflects the holistic sustainability approach adopted by the evaluated unit. It is technical on what relates to the definition of results and represents an important step towards the conception of appropriate measurement instrument of food and agriculture sustainability tradeoffs. It contemplates various aspects of sustainability derived from well recognized tools, certifications and international sustainability agreements.

The approach adopted by SAFA Smallholders App aims at addressing the well being of farmers, flora, fauna, communities, business, retailers and stakeholders that belongs to food industry where smallholder farmers are inserted. Such characteristics position the tool as a holistic instrument so needed nowadays where tradeoffs are urging to be unveiled to society.

Four main constraints and limitations were identified during the application of the SAFA App, when analysing sustainability of 407 rural properties in Southern Brazil, as detailed below and synthesized in Table 1.

DIMENSION: Environmental Integrity

Theme: Atmosphere sustainability

Indicator: GHG Mitigation Practices

Question: 33

Which statement best describes the current area covered by trees on your farm?

The indicator considers a “Good” scenario only when the evaluated smallholder property presents 50% or more of its area covered by trees. It may lead into an unfair interpretation and consequent score down properties that have less than such tree coverage percentage, ignoring the pertinent country legislation even when farmers act in accordance to it.

The Brazilian environmental legislation regarding the forest preservation, here defined as Forest Code (FC), was created in 1965. The FC was transformed during the 1990s into a de facto environmental law via a series of presidential decrees. FC requires landowners to conserve native vegetation on their rural properties, setting aside a Legal Reserve (MMA, 2012).

The law also designated environmentally sensitive areas as Areas of Permanent Preservation (APPs), aiming to conserve water resources and prevent soil erosion. APPs include both Riparian Preservation Areas that protect riverside forest buffers, and Hilltop Preservation Areas at hilltops, high elevations, and steep slopes (MMA, 2012).

Depending on the biome in which the property is located, the Forest Code establishes the percentages for legal reserve. The Code defines the percentage of trees / shrubs or any type of cover to be preserved based on the original biome that the area belongs to. E.g. rural properties located at the Amazon biome must preserve 80% of its area, the one´s located at the Cerrado Biome, 35% and 20% in other regions and biomes.

By considering these aspects we assume that a percentage of 50% related to the area covered by trees in the area under evaluation does not apply nor represents the Brazilian reality as this country has clearly defined the thresholds on the matter.

The positive implications of adopting this consideration could rest on the fact that properties respecting the pertaining Forest Code or any analogous

country legislation, unquestionably will accomplish a “Green” score in the related indicator.

DIMENSION: Environmental Integrity

Theme: Atmosphere sustainability

Indicator: GHG Mitigation Practices

Question: 37

Does your farm consist mostly of ruminant production (e.g. cattle, goats, and sheep)?

Concerning the GHG emission, the SAFA Smallholders tool classifies any production model oriented to ruminant species as a harmful agriculture system. By doing it so, the tool assumes that any livestock production model is harmful to the environment. However, there is enough evidence that proper ruminant livestock and forage management has the potential to notably offset the GHG emissions derived from its own operations.

Alongside a research on integrated crop livestock systems, Rao and contributors (2015) reviewed the potential of the combination of livestock with improved forages to mitigate GHG emissions, contrasting forage-based systems with feedlot systems, and concluded that the ecological footprint of forage based systems was lower than that of feedlots. Livestock-related interventions, including better management of crops and grassland and the restoration of degraded land and soils, can mitigate as much as 3.5 Bt CO2-eq/yr.

The potential of suitable animal and improved forages management to accumulate C under adequate pasture is second only to forests (Fisher et al. 2007; Blanfort et al. 2012). A plausible 30% adoption rate of improved deep-rooted Brachiaria pastures integrated with livestock in the Cerrados of Brazil would represent a mitigation potential of 29.8 Mt CO2-eq/yr (HERRERO et al, 2010).

Well managed livestock, grass and grass + legume pastures have a huge potential to accumulate C, with values comparable with planted forests. (RAO et al 2015). Moreover, forages that are well-adapted to edaphic and climatic stresses under a correct grazing management, have a higher potential to accumulate C than field crops, which have lower net primary productivity, particularly in marginal conditions.

DIMENSION: Social Wellbeing

Theme: Human Health and Safety

Indicator: Workplace safety and health provisions

Question: 69

How long must you travel to reach medical care (nurse, doctor, or clinic) using the most common transportation method?

The presented SAFA indicator assumes that the onus for not having access to medical care with an adequate distance lies on farmer responsibility. It does not consider that the government in many countries is accountable for this type of social service.

It is important to adapt the indicator variables to draw the responsibility of smallholder farmers by recognizing the local pertaining authority as the figure on duty of it. In considering these circumstances, farmers will not be liable by the mismanagement of the local authority.

The Brazil is an example of such assertion as the health care is a right for every citizen and a duty for the government, as established in Brazil's 1988 Federal Constitution. Health is simultaneously a social and a fundamental constitutional right, and cannot be removed by any amendments as stated on such Magnus document. The Brazilian government is obligated to provide free and accessible universal health care for its population, regardless of income under principles of universality and equity (MACHADO et. al. 2014).

The 1988 Brazilian constitution on the Article 198, called for a Unified Health System (SUS) that organized a regionalized and decentralized network of health services, with coordinated management at each level of government, community participation, and the prioritizing of prevention as part of an integrated approach to health services delivered over the national territory (Elias et.al. 2003).

DIMENSION: Good Governance

Theme: Rule of Law

Indicator: Tenure Rights

Question: 95

Do you feel secure with your tenure?

The SAFA Smallholders guidelines definition on Tenure Rights qualifies its associated indicator as unacceptable if a farmer does not secure his / her

own land tenure. The issues surrounding land ownership and user right subject are amongst the most demanding challenges of crafting land tenure reforms for the benefit of the world's rural poor.

Once more, SAFA Smallholders seems to transfer the responsibility on land tenure issues to the smallholders despite the local responsible entity. It may fall into the same previous identified problem where the entity evaluated becomes responsible over something that is beyond their responsibility.

To have a glance on the importance of this subject, the bulk of the 70-75% of the extreme poor on our planet who make their livelihood in the rural sector fall into one of three great groups (altogether summed up around 1.25 billion people) who lack secure land rights (PROSTERMAN et al., 2009):

-tenants or agricultural labourers on lands of private owners;

-members of collective farms who have not yet received secure individual land rights in a break-up; and

-squatters on land claimed under public ownership.

As stated by IFAD (2015), policies and legislation must recognize the many facets of land rights and usage. Above all, poor rural people must be empowered to participate in policy formulation to ensure that their needs and rights are addressed and protected.

These evidences supports the idea of a smallholder farmer cannot be held responsible by the fact that tenure rights are not secured, as it goes beyond someone´s will, depending manly on public policies specially focused on the matter.

4.4 SUGGESTIONS FOR SAFA SMALLHOLDERS APP. IMPROVEMENT:

Regarding the question number 33, we suggest to consider the aspects of national equivalent environmental legislation; regarding the country where SAFA Smallholders is employed, into the underlined indicator variables options. The positive implications of this approach could rest on the fact that properties respecting the pertaining Forest Code or any analogous country legislation, unquestionably will accomplish a "Green" score in such indicator.

For the question number 37 we advise the addition of complementary variables into the set of the related question options such as the adoption of integrated crop livestock systems / mixed systems, grazing management, etc.. It could assist identifying and distinguishing farmers that are committed to environmental friendly attitudes such as Climate Smart Agriculture principles and practices (FAO, 2013) implemented within their rural properties instead of merely down classifying them by the type of livestock explored.

By presenting the exposed data we aim to clarify that the appropriate livestock management, with special emphasis on forage management under an integrated crop livestock systems model and its variations, may possibly contribute to green house gases emission offset.

Aggregation of a No Go variable into its set of options of the question number 69. E.g. Is the local responsible health care authority well represented in your community? If not, the score is neutral. If positive, the other variables should be considered as the original document proposes.

The tenure rights indicator, question number 95, may be reconsider due to its sensitive status particularly if no contributions towards such rights were evidenced by the local authorities nor are part of country´s national land tenure right plans and values.

This indicator should add a “Comment” section explaining the support of local government on such issue. By doing so the explanation on the scenario pertaining to land tenure rights will be clarified helping the assessor and audience community to understand the score achieved by the evaluated entity.

Table 4.1: Limitations and constraints identified during the usage of SAFA SMALLHOLDERS App. in Rio Grande do Sul State. Brazil, 2017.

SAFA Smallholders App					Identified limitations & constraints
Dimension	**theme**	**indicator**	**related question**	**indicator variables**	
Environmental Integrity	***Atmosphere***	***GHG Mitigation Practices***	*Which statement best describes the current area covered by trees on your farm?*	*About half or more of my farm is covered by trees (score = green). Less than half of my farm is covered by trees (score = yellow). I do not have any trees on my farm (red).*	It may lead into an unfair interpretation and consequent score down properties, which are in accordance to their country laws that allows lower tree coverture without penalties.
Environmental Integrity	***Atmosphere***	***GHG Mitigation Practices***	*Does your farm consist mostly of ruminant production (e.g. cattle, goats, and sheep)?*	*Yes (score = red) and No (score = "green").*	It assumes that any livestock production model is harmful to the environment.
Social Wellbeing	***Human Health and Safety***	***Workplace safety and health provisions***	*How long must you travel to reach medical care (nurse, doctor, or clinic) using the most common transportation method?*	*Treatment at farm or under 1 hour (score = green). 1 to 3 hours (score = yellow). More than 3 hours (red).*	It assumes that the onus for not having access to medical care with an adequate distance lies on farmer responsibility. It does not consider that the government in many countries is accountable for this type of social service.
Good Governance	***Rule of Law***	***Tenure Rights***	*Do you feel secure with your tenure?*	*Yes (score = green). Somewhat (score = yellow). No (score = red).*	It transfers the responsibility on land tenure issues to the smallholders despite the local responsible entity

4.5 FINAL CONSIDERATIONS

The design of sustainability evaluation mechanisms is urging to take a place in the current demanding scenario. As a sustainability measurement tool, SAFA Smallholders App is uncomplicated to operate and quick to communicate the diagnosed sustainability scenario to the entity assessed at a real time, allowing quick response to the hot spot areas / areas in need if desired.

By adopting the observed figures and suggestions we believe that SAFA Smallholders App instrument might become fairer to the entities evaluated, underlining that any insights derived from up dated knowledge will be welcomed and useful.

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ANNEX – A

SAFA SMALLHOLDERS App questionnaire

Basic Information

1. Name of assessor:
2. Assessing organization:
3. Date of assessment:
4. Name of person being interviewed:
5. Gender of person being interviewed:
- ☐ Female
- ☐ Male

6. Is this person the farm owner?
- ☐ Yes
- ☐ No

7. Name of farm:
8. Village of farm:
9. Country of farm:
10. Does the interview take place on or close to the farm?
- ☐ Yes
- ☐ No

11. If you do know the GPS coordinates of your farm, please type them here:
12. OR Collect the GPS coordinates of the interview (function in the app)
13. Phone number of interviewee:
14. E-Mail of interviewee (if any):
15. What are the main crops and products that you produce?

Main product 1:	Main product 6:
Main product 2:	Main product 7:
Main product 3:	Main product 8:
Main product 4:	Main product 9:
Main product 5:	Main product 10:

16. Which best describes your level of commercialization? (check all that apply)
- ☐ I am a subsistence farmer
- ☐ I sell mostly to local markets/customers
- ☐ I am a fully commercialized farmer (sell goods mostly for export)
- ☐ I am a contract farmer (with a company or a public-private partnership)

17. Do you produce any livestock on your farm?
- ☐ Yes
- ☐ No

18. What is the size of the farm (local units and preferably, in hectares)?

Mission Explicitness

1. Do you have a statement about the farm‘s goals and values that you follow and that everyone on your farm understands? [weight: 1]

- Yes (green)
- Partially (yellow)
- No (red)

Accountability

2. Do you keep accurate records of your production processes (e.g., planting and harvesting information, input use) so they can be made available to producer organizations, customers or suppliers when required? [weight: 1]

- Always or often (green)
- Sometimes (yellow)
- Never or rarely (red)

Participation

3. Do you belong to a producer organization (or another agriculturally focused organization)? [weight: 1]

- Yes (green)
- No (red)

4. How much value do you feel the farm receives from being a part of the organization? [weight: 1]

- Significant value (green)
- Some value (yellow)
- Little or no value (red)

Conflict Resolution

5. How often have you been able to peacefully and successfully resolve any problems or conflicts that you have experienced with your suppliers, workers, producer’ organization or buyers? [weight: 1]

- Always or often (green)
- Sometimes (yellow)
- Never or rarely (red)
- There have not been any problems or conflicts with other stakeholders (neutral)

Sustainability Management Plan

6. Do you have a farm management plan that provides for the success of your production in the long run? [weight: 1]

- Yes (green)
- No (red)

7. How successful has this plan been? [weight: 1]

- Very successful (green)
- Somewhat successful (yellow)

8. which elements are part of your plan? (green for 3 choices or more, yellow for 2 choices, red for 1 choice or less).

- Finances
- Soil fertility management
- Environmental management
- Expansion/Staff
- Health and Safety
- Marketing

- Quality
- Processing or adding value
- Other

Profitability

9. Do you produce crops, animals, or agricultural products for sale or trade? [weight: 2]

- Yes (green)
- No (red) – no go

10. Do you know your farm revenue for the last production year? [weight: 2]

- Yes (green)
- No (red)

11. Do you know your paid labour costs for the last production year? [weight: 1]

- Yes (green)
- No (red)
- Not applicable (neutral)

12. Do you know your fertilizer, pesticide and seeds/plant material costs for the last production year? [weight: 1]

- Yes (green)
- No (red)
- Not applicable (neutral)

13. Do you know your animal feed, veterinary care and juvenile stock costs for the last production year? [weight: 1]

- Yes (green)
- No (red)
- Not applicable (neutral)

14. During the last five years, how often were farm revenues greater than costs? [weight: 1]

- All or most of the time (green)
- Some of the time (yellow)
- Rarely/Never (red) – no go
- I don‘t know (yellow)

Product Diversification

15. How many significant crops, products, or services are offered for sale? [weight: 1]

- Three or more significant crops, products, or services (green)
- Two significant crops, products, or services (yellow)
- One significant crop or product (red)

16. Do you do any processing or value adding in order to increase revenue from services or the sale price of your crops or agricultural products (e.g., tourism, butchered meat, drying coffee or fruit, processing jam)? [weight: 1]

- Yes (green)
- No (yellow)

Stability of Market

17. How many buyers do you have for your significant crops or products? [weight: 1]

- I usually have multiple people or places to sell my product(s) to (green)
- I usually have one or two people or places to sell my product(s) to (yellow)
- I do not have a regular person or place to sell to (red)

18. How is your relationship with your most important buyer? [weight: 1]

- Very reliable and consistent (green)
- Somewhat reliable and consistent (yellow)
- Unreliable (red) – no go

19. Do you feel that you have a choice in where to sell your products? [weight: 1]

- Yes (green)
- No (red)

Fair pricing and transparent contracts

20. Do you understand how buyer(s) calculate or establish prices paid? [weight: 1]

- Always or often (green)
- Sometimes (yellow)
- Never or rarely (red)

21. What type of market information did you know during the last production year? [weight: 1] Check all that apply (any of the first three answers gets a green score for the question):

- Prices paid by different buyers throughout the region for the same product
- Price my buyer received for the product
- Retail price of the product
- None (red)

Liquidity

22. Check the sources from which you could realistically get a loan if you needed one: [weight: 1] (two or more of the first four answers is green, one is red)

- Informal sources such as friends, relatives, or religious groups
- Banks, government lending institutions
- Directly from buyers (exporter, importer, roaster, trader)
- NGOs, cooperatives, farmer associations or microfinance group
- My only option would be to ask a loan shark (red) – no go

23. If you requested a loan during the last year, how much did you receive compared to the amount that you requested? [weight: 1]

- All or most (green)
- Some (yellow)
- None (red) – no go
- I did not request a loan during the last year (neutral)

24. Have you set aside savings? [weight: 1]

- Yes (green)
- No (red)

Safety Nets

25. Do you have crop related insurance? [weight: 1]

- Yes (green)
- No (red)
- It is not available (yellow)

26. Do you have a risk management plan that accounts for minimum costs or support in case of harvest loss (e.g., community supported schemes, agreements with cooperatives)? [weight: 1]

- Yes (green)
- No (red)

27. Have you implemented on-farm measures to reduce risk from variability in natural conditions and inputs (e.g. building a water tank)? [weight: 1]

- Yes (green)
- Some (yellow)
- No (red)

Food Quality

28. Do you take actions to maintain high quality in your crops and products (e.g. hygienic processing, proper storing and packaging, grading)? [weight: 1]

- Yes (green)
- No (red)

29. During the last two years, have you had a technical quality assessment of any of your main crops or products? [weight: 1]

- Yes (green)
- No (red)

Certified Products

30. Do you produce any crops, animals or products that meet, or are certified, to a standard? [weight: 1]

- Yes (green)
- No (yellow)
- I had a certification, but it was rescinded/taken away (red) – no go

31. How much of your main products or crops are sold as certified? [weight: 1]

- All or most (more than 80%) (green)
- Some (40%-80%) (yellow)
- Not much or none (less than 40%) (red)

Legitimacy

32. How do you ensure legal and regulatory compliance in general, including also any standard voluntarily entered into? [weight: 1] (green for 2 choices, yellow for 1 choice, red no choice)

- I use board agendas, other official records or notes of rights and compliances
- I keep licences and permits, if required by law
- I regularly report on compliance to auditors

GHG Mitigation Practices

33. Which statement best describes the current area covered by trees on your farm? [weight: 1]

- About half or more of my farm is covered by trees (green)
- Less than half of my farm is covered by trees (yellow)
- I do not have any trees on my farm (red)

34. /35. During the last production year was there any change to the number of trees on your farm? [weight: 1]

- Increase (include planting new trees from cuttings or from seed) (green)
- Decrease (removing focus crop trees, shade trees, natural forest trees, or other crop trees) (yellow)
- No change (green)

36. What is your main tillage method? [weight: 1 for both GHG and Land]

- Conventional (red)
- Reduced (yellow)
- No-till (green)

37. Does your farm consist mostly of ruminant production (e.g. cattle, goats, sheep)? [weight: 1]

- Yes (red)
- No (green)

38. What is the main type of manure management system used on the farm? [weight: 1]

- Open-air lagoon or discharged into water bodies (red)
- Compost or biodigestion (green)
- Direct use (collected and spread on cropping area, left on pasture) (yellow)

Air Pollution Prevention Practices

39. Do you use a smokeless fuel or chimney to vent smoke when cooking? [weight: 1]

- Yes (green)
- No (red)

40. Do you ever burn your fields? [weight: 1 for both Air pollution and Species conservation]

- Yes (red)

- No (green)

Soil Improvement Practices

41. What is the main type of fertilizer used on the farm? [weight: 1 for GHG and Soil]

- Natural fertilizers applied according to crop and soil needs (green for GHG and Soil)
- Natural fertilizers applied without knowledge of crop or soil needs (yellow for GHG and green for Soil)
- A combination of natural and synthetic fertilizers (yellow for GHG and Soil)
- Synthetic fertilizers applied according to crop and soil needs (yellow for GHG and Soil)
- Synthetic fertilizers applied without knowledge of crop or soil needs (red for GHG and yellow for Soil)
- None (green for GHG and red for Soil)

42. Which of the following are used to improve soil fertility on the farm? [weight: 1] (two or more of the first four answers is green, one is yellow)

- Cover crops
- Nitrogen fixing annual or perennial plants
- Intercropping
- Crop rotation for maintaining soil health
- None (red)

Nutrient Balance

43. How do you determine how much fertilizer (synthetic or natural) to apply to your crop(s)? [weight: 1]

- We apply fertilizer based on a careful assessment of our soil and crops (including farmer observation, professional tests, or analyses) (green)
- We apply fertilizer based on general advice for the region or for our crop(s) (yellow)
- We are not able to fertilize (red)
- We do not use enough fertilizer, but we apply as much as we can afford (yellow)

Land Conservation and Rehabilitation Practices

44. Which of the following are ways that you manage your soil? [weight: 1] (two or more of the first three answers is green, one is yellow)

- Maintain a permanent soil cover through mulch, planted soil cover, etc.
- Terracing or contour planting on areas of significant slope
- Hedgerows (e.g., trees and shrubs)
- Soils are often bare between cropping cycles (red)

Hazardous Pesticides

45. Do you use any synthetic (chemical) pesticides on your farm? [weight: 1 for Pesticides and Water pollution]

- Yes (red)
- Only occasionally (yellow)
- No (green)

46. Do any of the synthetic pesticides used on your farm have a red band around the container or on the label? [weight: 1]

- Yes (red) – no go
- No (neutral)

47. Do the pesticides used on your farm have labels that you understand? [weight: 1]

- Yes, they all have labels with instructions on dosage, safety, etc. that I understand (green)
- Some do not have readable labels (or are unlabeled) (red) – no go

48. Do you ever mix pesticides? [weight: 1]

- Yes (red) – no go
- No (green)

Ecosystem Diversity

49. Did you convert any natural land (prairie, forest, or savannah) to production land during the last five years? [weight: 2 for Ecosystem diversity and weight: 1 for Land]

- Yes (red)
- No, there is no natural land on the farm (neutral)
- No, natural land on the farm was left as is (green)

Species Conservation Practices

50. Do you have any of the following on your farm to preserve or restore natural species? [weight: 1] (two or more of the first three answers is green, one is yellow)

- Permanent set-aside (land taken out of production to create a habitat for biodiversity)
- Rehabilitated or restored natural areas
- Hedgerows or buffer zones
- None (red)

51. Check all of the pest and disease management practices used for the main crop(s) during the last production year: [weight: 1 for both Species conservation and Hazardous pesticides] (All four first choices should be marked for green, yellow if only some are marked)

- Conduct regular visual examinations of plants to detect pests or disease
- Use traps, repellants (including repellant species), and natural pesticides
- Create or preserve places (including plant species) for beneficial predators of pests to live
- Maintain written record of pest infestation, treatments, and results
- I use synthetic pesticides specific to the crop and/or pest at the proper dosage and timing (yellow)
- I apply synthetic pesticides preventatively (e.g., on a regular schedule regardless of whether a pest or disease threat currently exists) (red)

52. Which statement best describes the diversity of your farming system? [weight: 1]

- I produce multiple (4+) types of crops and/or livestock in the same area (green)
- I produce 2-3 types of crops and/or livestock in the same area (yellow)
- The majority of my farm is used to produce a single crop or one type of livestock (red)

Saving Seeds and Breeds

53. For the main crops and livestock produced on the farm, do you use any locally adapted varieties of seeds or breeds? [weight: 2]

- Yes (green)
- No (red)

54. What is the main source of your seeds or breeds? [weight: 1]

- Saved by the farmer, obtained from neighbours, or from a local seed bank (or breeding program for livestock) (green)
- A combination of local and non-local sources (yellow)
- Completely reliant on external non-local sources (red)

Water Conservation Practices

55. Do you use water conservation practices on the farm? [weight: 1]

- Yes (green)
- No (red)
- Sometimes (yellow)

56. Do you irrigate your crops? [weight: 1]

- Yes (neutral)
- No (green)

57. What form of irrigation do you use? [weight: 1]

- Manual irrigation (hand watering) (yellow)
- Surface irrigation (red)
- Drip irrigation (green)

Water Pollution Prevention Practices

58. Which of the following statements apply to your farm? [weight: 1]

- The land I use for cultivating crops and/or for pasturing animals is directly next to natural waterways (red)
- Pesticide application equipment is cleaned in natural water bodies (red)
- Untreated domestic or processing water is discharged into natural water bodies (red)
- None (green)

Renewable and Recycled Materials

59. How do you manage crop residues, processing residues, and organic matter? [weight: 2]

- Reused (e.g., through compost, as a soil cover, animal feed, biofuel or other uses) (green)
- Burned or discharged into waterways (red)
- Left in piles or taken off farm (yellow)

60. Do you recycle or reuse metal, plastic containers or bags (with the exception of agrochemical containers), paper or cardboard? [weight: 1]

- Yes (green)
- No (red)
- Not applicable (neutral)

Energy Use/Energy consumption/Renewable energy

61. If you use electricity, charcoal, wood, or fuel sources of energy, are you improving your efficiency? [weight: 1]

- I can demonstrate that I reduce energy use (e.g., through fuel efficient stoves, solar drying, well-maintained machinery, switching from wood to gas) (green)
- I have made some efforts to reduce energy, but I have not applied them to most of my farm (yellow)
- I do not make any attempts to reduce energy (red)

62. If you used wood or charcoal for energy during the last production year, what was the main source? [weight: 1]

- Purchased, I don‘t know (yellow)
- Managed natural forest with limited extraction (green)
- Unlimited forest use (red)
- Managed plantations or planted woodlots (green)
- Tree pruning (green)
- Not applicable, I do not use wood or charcoal energy (neutral)

63. Do you use any of the following renewable energy sources for a significant portion of your energy needs? [weight: 1] (any green answer gets a green for the indicator)

- Solar (green)
- Hydropower or geothermal (green)
- Wind (green)
- Biofuel from farm or household waste (green)
- None of the above (yellow)

Food Loss and Waste Reduction

64. Which of the following best describes your pre- and post-harvest losses (i.e., the amount of crop lost during production, storage, and transport) during the last production year? [weight: 1]

- Minimal (less than 10%) (green)
- Some (10-30%) (yellow)
- Substantial (more than 30%) (red)

65. Do you take active steps to reduce pre- and post-harvest losses on your farm (through improving storage and transport methods, pest/disease management, harvesting at the appropriate time, etc.) [weight: 1]

- Yes (green)
- No (red)

Animal Health and Welfare

66. Do you have access to veterinary care for the livestock on your farm? [weight: 1]

- I do not have access (red)
- I have access, but it is problematic (unqualified personnel, too costly, too distant, or it is inhumane) (yellow)
- I have access to veterinary services that are of good quality, affordable, and nearby (green)

67. Which statement best describes the way livestock diseases are managed on the farm? [weight: 1]

- I give animals medication routinely to prevent them from becoming sick (red)
- I follow my veterinarian or a local expert‘s recommendation for the treatment of diagnosed diseases (green)
- I do not consult professionals or experts about animal diseases (yellow)
- I do not provide my livestock with any veterinary care (red)

68. Which of the following most accurately reflects the general state of well-being and living conditions of animals on the farm? [weight: 1]

- I practice animal husbandry that provides animals with adequate space, shelter that is kept clean and does not crowd animals, a sufficient and balanced diet, and I prevent unnecessary distress (green)
- Animals have adequate living conditions, sufficient feed, and I try to prevent unnecessary distress, but there is room for improvement (yellow)
- Animals are kept in unsanitary or inadequate shelter conditions, are limited in expressing natural behaviours, do not have access to adequate feed, or measures are not taken to keep animals from experiencing unnecessary distress (red) – no go

Safety of Workplace, Operations and Facilities

69. How long must you travel to reach medical care (nurse, doctor, or clinic) using the most common transportation method? [weight: 1]

- Treatment at farm or under 1 hour (green)
- 1 to 3 hours (yellow)
- More than 3 hours (red) – no go

70. How affordable is the nearest medical care for the farm‘s household members and workers? [weight: 1]

- Treatment is free, or costs are low and do not cause difficulty (green)
- Costs are difficult, but not so high as to keep household members and workers from obtaining treatment when needed (yellow)
- Costs are so high that household members or workers avoid treatment even for very serious conditions (red) – no GO

71. How long must people on the farm travel to reach water they consider safe to drink? [weight: 1]

- Water is available on site, or is 5 minutes or less away (green)

- More than 5 minutes, but less than 20 (yellow)
- More than 20 minutes (red) – no go

72. Do members of your household and others who live on your farm have consistent access to sufficient and adequate water for human use (i.e., for water intake, hygiene, and cooking needs)? (As a reference point, 15 litres per person per day is generally considered adequate) [weight: 1]

- Yes (green)
- Most of the time (yellow)
- No (red)

73. Do any of the following apply pesticides on the farm? [weight: 1]

- Pregnant women (red)
- People under 18 (red)
- People untrained in pesticide application (red)
- None of these groups apply pesticides on the farm (green)

74. What protective equipment is used when synthetic pesticides are applied? [weight: 1] (All 4 answers must be marked for green, yellow for some)

- Plastic or rubber gloves
- Breathing masks (not just handkerchiefs)
- Protective outer clothing (should cover body with impermeable material)
- Protective foot gear (rubber or plastic boots)
- None (red) – no go

75. Did you have more than one serious injury on your farm during the last year (enough to require medical attention)? [weight: 1]

- Yes (red)
- No (green)

76. How well are you prepared to avoid risks on the farm and to handle emergencies? [weight: 1] (All 3 answers must be marked for green, yellow for two, red for one or none)

- I have first aid kits on the farm (e.g. bandages, antiseptics)
- I warn my employees of potential hazards on the farm and how to handle them (e.g. snake bites)
- I properly store dangerous tools and well maintain machinery

Capacity Development

77. What type of training(s) did you attend during the last year? (Training is considered to be a half-day or more) [weight: 1] (three or more types of training is green, one or two is yellow)

- Improving farming operations (agricultural practices or processing practices)
- Improving record keeping (on farming operations traceability and book keeping)
- Marketing support (information and education about topics such as prices, market contacts)
- Health and safety issues
- Environmental issues
- Adult literacy
- Managing the farm‘s business or finances
- Other
- I did not participate in training (red)

Labor

78. Do you hire paid labor? [trigger question, not rated]

- Yes
- No

Employment relations

79. Would you be willing to hire workers of different social groups (e.g. ethnic/religious minorities) at the same wage rate of a local man of the dominant ethnicity and religion? [weight: 1]

- Always or often (green)
- Sometimes (yellow)
- Never or rarely (red) – no go
- Not applicable (neutral)

Freedom of Association and Right to Bargaining

80. Are hired workers free to associate with colleagues or unions and do they have the right to bargain their employment conditions? [weight: 1]

- Definitely do (green)
- Sometimes (yellow)
- Definitely don‘t (red)

Forced Labour

81. Are hired workers free to leave their employment at any time, with reasonable notice and in accordance with working agreement (formal or informal)? [weight: 1]

- Yes (green)
- At a price (e.g. penalty, non-payment of wage, loss of privileges) (red)

Child labor

82. Which of the following statements apply to children younger than 16 years working on the farm (whether or not they are paid)? [weight: 1]

- Children work on the farm with family in a way that allows them to attend school (work less than 20 hours a week) (green)
- Children work on the farm instead of going to school (work more than 20 hours a week) (red)
- Children do not work on the farm (green)

Non-discrimination

83. In case of harassment or discrimination amongst your employees (e.g. sexual harassment of women), how would you respond? [weight: 1]

- I am comfortable implementing a procedure to protect vulnerable groups (green)
- I do not have a plan or procedure, but I would take action (yellow)
- I would not personally take action (red)

Gender equality

84. Are both men and women active on the farm? [trigger question, not rated]

- Yes (neutral)
- No (neutral)

85. What portion of the decisions about the farm‘s significant crops/products are made by men on the farm? [weight: 1]

- All or most (red)
- About half (green)
- Few or none (red)

86. What portion of the decisions about the farm‘s significant crops/products are made by women on the farm? [weight: 1]

- All or most (red)
- About half (green)
- Few or none (red)

87. Do girls and boys on the farm have the same educational opportunities? [weight: 1]

- Yes (green)

- No (red)
- Not applicable, there are no children on the farm (neutral)

88. Do men and women on the farm have the same training opportunities? [weight: 1]

- Yes (green)
- No (red)

Regional workforce

89. If you hire labour, what is the main source of your workers? [weight: 1]

- I hire mostly workers from the local community (green)
- I hire mostly migrant workers or workers from outside my local community (red)
- I hire workers from the local community and also migrants or those outside of my community (yellow)
- I tried to hire local workers but was unable to do so, due to circumstances that did not depend on me (yellow)
- Not applicable (neutral)

Food Sovereignty

90. How much do you agree with the following statement: I have the option to choose to produce the crops and products that I want to on my farm? [weight: 1]

- Agree (green)
- Neither agree or disagree (yellow)
- Disagree (red)

91. Do all members of the household have access, every day, to adequate nutrition in a culturally appropriate and satisfying way? [weight: 1]

- Yes (green)
- No (neutral)

92. How many days during the last production year did any member of the family cut the size of meals or skip meals because there wasn‘t enough food? [weight: 1]

- 1-9 days (yellow)
- 10-29 days (red)
- 30 or more days (red) – no go

Indigenous knowledge

93. Do you consider that your product has a higher value-added thanks to traditional/indigenous knowledge? [trigger question, not rated]

- Yes (neutral)
- No (neutral)

94. Do you have a connection with the community where the traditional/indigenous knowledge has originated from? [weight: 1]

- I am a part of the community myself (green)
- Formal link with sharing of benefits (e.g. royalties or sharing profits) (green)
- Informal link to ensure the preservation of knowledge (yellow)
- No link established (red)

Tenure rights

95. Do you feel secure with your tenure? [weight: 1]

¡¡Yes (green)

- Somewhat (yellow)
- No (red)

96. Are there practices or investments you would like to implement on your farm but cannot because of tenure constraints? [weight: 1]

- Yes (green)
- Possibly (yellow)

- No (red)

Community Investment

97. Do you participate in any community welfare projects (e.g., building community facilities, roads, schools, clinics, water works; organizing youth activities; or donating food or produce to community events), or do you undertake activities that have direct benefits for your community (e.g., managing a shared forest, building ponds for water management)? [weight: 1]

- Yes, I regularly participate in or organize projects that benefit my community (green)
- I am aware of projects like these in my community, and I participate in them occasionally (yellow)
- I do not participate in community welfare projects (red)

Quality of Life

98. What is your opinion of the overall quality of life (e.g. in terms of time, money and lifestyle) on the farm compared to the previous year? [weight: 1]

- Good (green)
- Not good, not bad (yellow)
- Bad (red)

Wage level

99. Which of the following can you afford comfortably based on your income, without compromising time for weekly rest and holidays? [weight: 1] (green for all selected, yellow for 5 to 8 choices, red for 4 choice or less)

- Three meals a day for myself and my family that include fruits and vegetables, and meat if I choose to eat it
- Appropriate clothing for myself and my family including shoes, clean clothes for school or work, warm clothes in winter, etc
- Medical care, including visits to doctors for myself and my family, and prescriptions or medications
- Educational expenses for children including school fees, uniforms, books and transportation
- Sufficient clean drinking water in my home
- Access to safe means of transportation
- Housing that is safe and protects from the weather
- Energy expenses that allow light and adequate heating or cooling (such as fans or heaters), when necessary
- Savings of at least 10% of my income to set aside for cultural or recreational activities and other expenses

100. Which of the following can your employees afford comfortably, based on the wage rate that you pay them, without having to have a second source of income? [weight: 1] (green for all selected, yellow for 5 to 8 choices, red for 4 choice or less)

- Three meals a day for themselves and their family that include fruits and vegetables, and meat if they choose to eat it
- Appropriate clothing for themselves and their families including shoes, clean clothes for school or work, warm clothes in winter, etc
- Medical care, including visits to doctors for themselves and their families, and prescriptions or medications
- Educational expenses for children including school fees, uniforms, books and transportation
- Sufficient clean drinking water in their homes
- Access to safe means of transportation
- Housing that is safe and protects from the weather
- Energy expenses that allow light and adequate heating or cooling (such as fans or heaters), when necessary
- Savings of at least 10% of their income to set aside for cultural or recreational activities and other expenses

5 CONSIDERAÇÕES FINAIS E SUGESTÕES

Declínios na qualidade dos recursos naturais - incluindo solos, água e biodiversidade e o emprego de estratégias desvinculadas das aptidões do ambiente e dos seus atores, se apresentam como fatores limitantes à conciliação da segurança alimentar com a preservação dos recursos naturais renováveis e não renováveis em escala global.

Como resposta a este cenário, a democratização dos conceitos e dos meios necessários à implantação e gestão das boas práticas agropecuárias, se apresenta fundamental à sustentabilidade do meio rural e da manutenção das suas multifuncionalidades.

Nesta perspectiva, este estudo objetivou contribuir com o entendimento das potencialidades e limitações dos sistemas integrados de produção agropecuária (SIPA) enquanto instrumento promotor de processos de desenvolvimento rural sustentável.

Empós sua realização, foi constatado que iniciativas promotoras de SIPA - quando sustentadas por ações que fomentam a participação equitativa das partes interessadas (nas distintas fases de projetos / programas) somadas à adoção de boas práticas agropecuárias, exercem um papel primordial na promoção do almejado desenvolvimento agrícola e rural sustentável.

Também, os SIPA se apresentam como estratégia viável ao aumento da resiliência econômica, proteção e utilização racional dos recursos naturais intrínsecos à sua materialidade, uma vez que tal modelo de produção, quando apropriadamente empregado, explora coerentemente e sinergicamente tais ativos.

Tendo em vista o esforço do autor e colaboradores pela ratificação da adoção dos SIPA, como potencial instrumento promotor de processos de desenvolvimento rural, enfatiza se neste documento a necessidade de se incorporar às linhas de pesquisas relacionadas ao seu âmbito, ferramentas úteis à identificação das necessidades e demandas socioeconômicas e ambientais do meio rural, portanto, representativas das realidades do meio rural.

Igualmente importante, é ressaltada a importância pela agregação à pesquisa de SIPA, de elementos nacionais como a utilização de espécies

arbóreas e forrageiras nativas, somado à busca pela gradativa substituição de recursos naturais não renováveis por aqueles renováveis, reconhecidos aqui como aspectos míster à sua consolidação como modelo de produção agroalimentar responsável.

Segundo o autor, é recomendada a utilização de ferramentas consagradas de avaliação da sustentabilidade de sistemas agropecuários nas etapas de diagnóstico inicial e avaliação *Ex – Post facto* dos projetos em SIPA. Dada asserção objetiva não abstruir nem sobrevalorar os benefícios procedentes do emprego destes modelos de produção agropecuária.

Finalmente, com o intuito de coletivizar os resultados oriundos dos trabalhos de ensino, pesquisa e extensão em SIPA, a comunicação adequada e apropriada dos benefícios e desafios deste modelo de produção agropecuária à ampla sociedade, deverá fazer parte da agenda das instituições envolvidas na sua promoção e emprego.

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