Title: Agricultural Insurance through the Lens of Rural Household Dietary Diversity

Abstract:

Agricultural insurance is considered a promising instrument to manage climate risks and to enhance the food security of smallholder farmers. However, despite some positive evidence that insurance positively affects farmers' production strategies, consumption smoothing, asset protection, and asset recovery, the specific effect of insurance on farm households' dietary diversity is largely unexplored. Often, positive effects on dietary diversity are presumed through income gains that might arise from investment returns of profitable production activities and cash gains from payouts. We argue that there exist multiple other causal mechanisms through which insurance may even negatively influence farm households' dietary diversity. The current article elaborates these mechanisms and provides recommendations on ways to avoid unintended negative effects on dietary diversity which should be taken into account by governments and donors if they continue to further promote insurance.

Key words: Agricultural insurance; Dietary diversity; Production diversity; Local market; Smallholder

1. Agricultural insurance: a tool reckoned to improve the well-being of farmers but with potential counteractive effects on dietary diversity

Agricultural insurance against production risk is considered to be a promising instrument for managing the increasing climate risks that smallholder farmers face and to enhance food security (BMZ 2015; Carter et al. 2018). Globally, billions of dollars are spent by governments to subsidize insurance premiums, with global initiatives committing substantial funds to support insurance solutions (Collier et al. 2009; Hazell et al. 2019; Müller et al. 2017). The growing number of pilot projects by international development institutions and national governments across many low income countries (see Di Marcantonio and Kayitakire 2017) indicates the determination of policymakers to promote agricultural insurance to smallholder farmers. On the other hand, the demand for insurance has remained low among smallholders.

Theoretically, agricultural insurance is supposed to contribute to the wellbeing of smallholder farmers in two ways. First, by transferring risk outside the farm, farmers are expected to start engaging in high-risk, high-profit production activities that would otherwise not be possible in the

absence of insurance (Carter et al. 2018; Janzen and Carter 2019). Consequently, high-profit production activities are expected to improve farmers' welfare by maximizing investment returns. Second, in event of a shock, payouts from insurance should help prevent the sale of household assets and minimize consumption reduction, which would otherwise be the main coping strategies of farmers without insurance (Carter et al. 2018; Janzen and Carter 2019). Accordingly, existing academic literature focuses on studying how insurance affects production decisions as well as the consumption smoothing and asset protection behaviors of smallholder farmers. The theoretical prediction of positive effects of agricultural insurance is supported by some empirical studies and field experiments finding that agricultural insurance influences farmers' choice of production strategies (Cai et al. 2014; Cai 2016; Cole et al. 2017; Delavallade et al. 2015; Hill et al. 2017; Karlan et al. 2014) and positively affects asset protection, recovery, and consumption smoothing (Bertram-Huemmer and Kraehnert 2018; De Janvry et al. 2016; Janzen and Carter 2019). However, some studies suggest that the long term effects of insurance on agricultural decisions and household well-being indicators are rather weak (Tobacman et al. 2017). A few researchers, e.g., Müller et al. (2017) and Capitanio et al. (2015), emphasize the potential unintended socio-ecological consequences of agricultural insurance, although the latter does not focus on the agricultural context of low income countries. Formal insurance might, for example, crowd-out existing informal risk-sharing mechanisms (Takahashi et al. 2018; Lenel and Steiner 2020) or lead to intensification through agrochemical input with negative ecological effects (Hill and Viceisza, 2012; Karlan et al., 2014; Sibiko and Qaim, 2017).

We underline that a fundamental aspect of farmers' well-being and food security – dietary diversity– is omitted from both academic articles and non-academic discourses of agricultural insurance. By affecting the production and economic decision behavior of farmers, agricultural insurance may affect smallholder households' dietary diversity through multiple causal links. On the positive side, when insurance-induced production choices result in actual gains in farm income, this will relax income constraints, one of the main determinants of a household's dietary quality. For households facing financial constraints, it means that higher income could be used to purchase diverse food that ultimately positively affect dietary diversity. Nevertheless, beyond making assumptions about the positive effects of insurance on food security through income gains and insurance payouts, studies on the specific effect of agricultural insurance on dietary diversity are scarce.

In this article, we highlight multiple causal mechanisms through which agricultural insurance may negatively affect dietary diversity in a smallholder context. Perceiving the urgent need to recognize these potential causal mechanisms and to take action to minimize unintended effects, we focus on the potential negative consequences. In section two of this article, we reflect on the theory behind, and empirical evidence on, how agricultural insurance could influence production diversity and local market-level food diversity; as well as how production and market diversity subsequently influence the dietary diversity of smallholder farmers. Following the discussion of causal links, we provide recommendations on ways to minimize potential negative effects which should be taken into account by governments and donors when they decide to further promote insurance. These discussions are crucial as undernutrition due to poor dietary diversity is a widespread problem among rural communities (Arimond and Ruel 2004; Müller and Krawinkel 2005). The short- and long-term consequences of undernutrition are detrimental and wide ranging, i.e., negatively affecting the health, growth, cognitive development, and economic productivity of people (Victora et al. 2008). Without careful consideration of the multiple causal mechanisms during the design and promotion of insurance, insurance may have unintended negative consequences for farmers' wellbeing.

We discuss these causal mechanisms in light of agricultural insurance that focuses on production risks. Insurance against production risk is either indemnity-based or index-based. While in indemnity-based insurance payouts are determined through on-site loss verification of individual cases, index based insurance payouts are derived from the value of an index such as a weather variable which serves as a proxy for a loss (Ceballos et al. 2019). Besides reducing transaction costs, index-based insurance optimally addresses the moral hazard problem that is commonly associated with indemnity-based insurance (Ceballos et al. 2019). Further, agricultural insurance is often subsidized in various ways for several reasons (Hazell and Varangis 2019). Subsides have been provided in the form of premium subsidy, administrative and operational supports to insurers, and direct payments to insurers to support claim settlement (Hazell and Varangis 2019).The causal mechanisms we discuss should be considered for both subsidized and unsubsidized insurance, irrespective of the specific form of agricultural insurance. In addition, the discussion we raise is crucial despite the low uptake of insurance so far. We have reasons to presume an increase in insurance uptake in the future: future insurance related innovations and technological advancements such as the application of picture-based insurance (Ceballos et al. 2019) and the use

of remote sensing data (de Leeuw et al., 2014) that may lower insurance costs, as well as potential increases in weather risk that might shape farmers risk perception and decision (Bjerge and Trifkovic, 2018; Grothmann and Patt 2005) to purchase insurance.

2. Potential causal links between agricultural insurance and dietary diversity

In the following sub-sections, we discuss four mechanisms through which insurance may have unintended negative consequences for farm households' dietary diversity. Figure 1 presents the schematic representation of these causal links between agricultural insurance and dietary diversity. The importance of each mechanism varies across the spectrum of systems from subsistence to market-oriented farming. The following discussions as well as the schematic representation of the mechanisms highlight these aspects.

I. In the absence of dietary knowledge, income gains from insurance may alter farmers' expenditure habits

One may have the expectation that insurance will automatically have a positive impact on dietary diversity for semi-subsistence and market-oriented farmers who are involved in market transactions by increasing investment returns from high-profit production activities. We argue that this may not always be the case unless careful consideration of dietary diversity aspects is included in insurance promotion. The expectation that nutritional outcome has overall higher positive income elasticity is both a prevailing thought as well as a debated one (Carletto et al. 2017; Jawara and Thiele 2018; Skoufias et al. 2011). Several empirical studies find that increasing farm income does not always result in improved nutritional outcomes (Kirk et al. 2018). It is hypothesized that farmers sometimes choose not just to divert the additional income to non-food expenditures but also to purchase luxurious albeit poor dietary quality food items. A number of interacting factors influence households' food purchasing and consumption decisions. While income is a critical determinant to access food, knowledge about the importance of consuming diverse food also significantly affects dietary choices. Studies show that better educated farm households that are considered to have better dietary knowledge and participants of nutrition education interventions are more likely to consume diverse foods (Boedecker et al. 2019; Murendo et al. 2018). Households' expenditure habits are particularly relevant in determining dietary choices. Therefore, an increase in income from insurance alone is not a sufficient condition for dietary improvement, as the gains may not always translate to positive dietary choices unless the farmers understand the need to consume

diverse food items. On the contrary, by affecting farmers' expenditure habits, income gains from insurance can have unintended negative impacts on household dietary diversity. Here, this causal mechanism is not specific to insurance; other technological interventions that solely focus on enhancing income gains without due consideration of dietary diversity could have a similar effect. However, if policymakers aim at improving food and nutrition security through insurance (BMZ 2015), they should recognize this unintended potential causal mechanism.

II. **Reduced availability of diverse food from own farm**

As insurance payments in events of shock are often attached to a specific crop, insurance induces farmers to focus on producing and allocating more land to insured crops by substituting away from uninsured crops. In this way, insurance is likely to encourage less diversified, if not monoculture, systems (Fuchs and Wolff 2011) by influencing farmers' production strategies that aim to maximize gains from the insurance investment. Farmers' desire to allocate more land to insured crops is also logical in terms of the benefits of economies of scale that could arise from specialization. Although available studies are few, empirical evidence shows trends to increase the production area of insured crops that are linked to insurance participation (Cai 2016; Cole et al. 2017; Elabed and Carter 2014; Karlan et al. 2014). Through this mechanism, insurance may affect the degree of on-farm food diversity that may, in turn, have dietary diversity implications for households. Especially for subsistence and semi-subsistence farmers producing mainly for their own consumption, on-farm diversification is relevant for dietary diversity. Several studies show that on-farm diversity is positively associated with household dietary diversity (Jones 2017; Zanello et al. 2019; Dillon et al., 2015; Bellon et al., 2016). This literature emphasizes the importance of farm-level production diversity to improve rural society's dietary diversity. However, there also exist other studies that argue further diversifying already diversified farms in smallholders system will not be efficient to improve households dietary diversity as there will likely be a forgone income opportunity from specialization (Sibhatu et al. 2015; Sibhatu and Qaim 2018). These studies suggest improving market access as a more effective strategy to enhance dietary diversity of rural households.

III. Reduced availability of diverse food in local markets

Local markets remain the primary source of food purchases for non-self-sufficient smallholder farmers in rural settings. As a result, the availability and diversity of food products in local markets has crucial implications for food and nutrition security. An empirical study by Zanello et al. (2019) indicates that the diversity of foods available in a market is positively related to dietary diversity. Semi-subsistence and market oriented farmers who satisfy their food demand from the market, as well as, to some extent, subsistence farmers who use non-farm income to purchase additional food from the market, are affected by the degree of diverse food available in the market. More importantly, local markets are a key source of crops that are important for quality diet, like fruits and vegetables, which are perishable and cannot be supplied from long distance markets (Ickowitz et al. 2019; Pellegrini and Tasciotti, 2014). If more and more farmers participate in insurance schemes and start substituting diversity for insured crops, regional or local level specialization might be promoted over time. This affects the diversity of food products supplied to local markets, with subsequently reduced market-level diversity limiting households' access to diverse food. In further effects, if farmers substitute vegetable or fruit production by insured cash or staple crops, these foods which are important element of quality diet may become expensive when supply is short in local markets (Ickowitz et al. 2019). Thus, the impact of reduced market-level diversity may also affect non-farming households living in the nearby areas as they become unable to purchase diverse food from the local market.

IV. Price risk and limited access to diverse food

Many rural areas have poorly integrated market systems with weak linkages to distant markets and consumers. Thus, the lack of a well-integrated market for output often limits market participation activities to local levels. As a result, farm and local level specialization due to insurance may result in a surplus supply of insured products to local markets and expose market-oriented farmers to price risks. Price risks would be higher for semi-subsistence and market-oriented farmers who are involved in market transactions. Reduced income in event of a price decline diminishes farmers' financial ability to purchase diverse food items. While, at first, a fall in prices may seem beneficial for buyers and consumers, the subsequent income losses due to lower prices may cause long-lasting harm to producers' welfare. Furthermore, if farmers are producing non-food crops, the dietary impacts of a price decline will be even more detrimental (Kirk et al. 2018) as the crop cannot be

consumed at home. Therefore, unless markets are well integrated, an increase in productivity may not result in gains for farm income, thus preventing any dietary benefit.

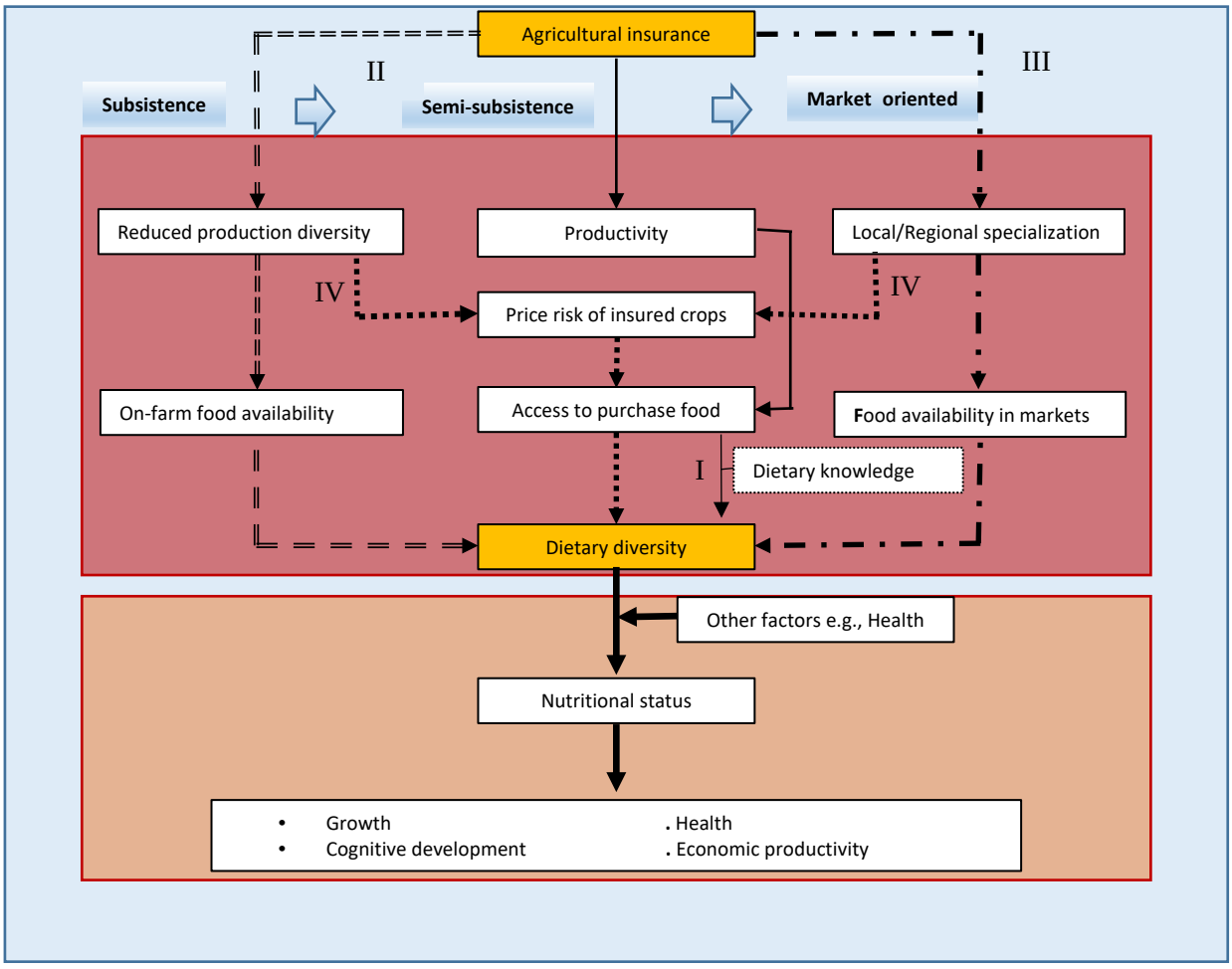

Figure 1 Schematic representation of potential causal links between agricultural insurance and dietary diversity in smallholders' context. Different line types represent the different causal mechanisms.

I — Altered farmers expenditure habits

II — Reduced on-farm food diversity

III — Reduced market food diversity

IV — Price risk

3. Recommendations to maximize the dietary diversity benefits of insurance

Many issues needing careful consideration in insurance promotion are already discussed in the literature, including issues related to index design, weather station infrastructure, legal frameworks, and scale (Barnett and Mahul 2007; Müller et al. 2017; Shirsath et al. 2019). It is also clear that insurance may not always be the most suitable strategy to manage the risks facing smallholder

farmers. Hazell and Varangis (2019) and Smith (2016) discuss other interventions and policy strategies that might be more appropriate to improve the food and income security of smallholders in some contexts. However, in contexts where insurance is presumed to be effective, several additional aspects must be considered for insurance to provide benefits for dietary diversity, as discussed below:

I. Bundle agricultural insurance with dietary education programs

Education on the importance of a diverse diet might promote conscious dietary choices. As a result, income gains from insurance could be used to maximize dietary benefits from purchased food. Nutrition education programs and advice are found to successfully improve dietary diversity and food security (Boedecker et al. 2019; Ragasa et al. 2019). Similarly, dietary information can be provided to insurance participating households to influence their dietary choices. Bundling insurance with services like agricultural advisory is already tested (Hill and Torero 2009). Furthermore, empirical data suggests that empowering women in domains such as purchasing decisions positively affects women's and children's dietary diversity (Galie et al. 2019; Heckert et al. 2019). Thus, strengthening women's access to income and decision powers could be an important element of making agriculture insurance sensitive to dietary diversity.

II. Reward diversification

Traditionally, diversification is a risk management strategy for farmers that hedges against production and market risks. Including diversification rewards in insurance design through reduced premiums or increased payments can encourage farmers to keep some level of on-farm diversity. On-farm diversification further serves and protects farmers against price risks that are not covered by marketed insurance. By reducing price risk, diversification helps to stabilize income; with several empirical studies showing a positive correlation between diversification and household farm income (e.g., Bravo-Ureta et al., 2006; Pellegrini and Tasciotti 2014; Michler and Josephson, 2017). Important lessons can be drawn from the Whole Farm Revenue Program in the US that uses a similar approach to encourage diversification (Müller et al. 2017; USDA 2019) .

III. Insure nutrient-dense agricultural products

Currently, many insurance products focus on non-food cash crops and staple crops, although livestock insurance is being piloted in a few pastoralist areas. Countries like India have already started providing insurance for fruits and vegetables (https://pmfby.gov.in/). In their food system

policy analysis in India, Thow et al. (2018) identify this insurance for fruits and vegetables as one of the policy strengths that can be expanded to enable the availability of diverse and quality diets. Insuring nutrient-dense crops, such as vegetables, fruits, and livestock, would encourage farmers to produce these foods, which, as a result, improves the availability of these important foods from their own farms and in the local market. Nevertheless, we acknowledge that insurance for vegetables and fruits might be more expensive than insurance for grains because of the higher costs of production, and the additional risks associated with failing to harvest on time that insurers may need to cover in vegetable and fruit production.

IV. Insure multiple crops simultaneously or a combination of crops and livestock products

Often a single crop or livestock insurance product is provided in a certain region, thus limiting the opportunity to diversify production activities. The simultaneous provision of multiple insurance products can open an opportunity for diversification at both the farm and local levels. Mixed crop-livestock systems could particularly benefit from the availability of both crop and livestock insurance products.

V. Insurance programs should in parallel support market integration projects

Many rural areas in low-income countries do not have a well-functioning market system. Well integrated market systems not only serve as a source of diverse food for local markets but also facilitate the sale of products to distant markets, thus minimizing the price risk from oversupply in local markets. Market integration would be particularly crucial as the reach of insurance expands to include farmers who have weak market ties, unlike the current insurance pilot projects that focus on farmers who have stronger market ties (Miranda and Farrin 2012). Therefore, international donor institutes and organizations that promote insurance should strengthen supporting initiatives that aim to improve market integration.

Concluding remark: If policy makers continue their effort to promote insurance and seek to use insurance to improve food security, there is an urgent need to strengthen strategies that consider the dietary diversity impacts in the design and promotion of insurance products. Furthermore, there is a need for empirical insights into the potential causal effects of various insurance products on rural households' dietary diversity under a wide variety of contexts. We acknowledge that some of the recommendation mentioned above may impose additional costs to insurance providers. If not

subsidized, the costs will make commercialized insurance more expensive for farmers. On the other hand, future innovations in insurance product designs by the private insurance sector may lower their costs and the development of insurance product that is dietary diversity sensitive may become financially feasible.

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