



The role of root and tuber crops in strengthening agri-food system resilience in Asia

A literature review and selective stakeholder assessment

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Gordon Prain
Diego Naziri



Food Resilience Through Root and Tuber
Crops in Upland and Coastal Communities
of the Asia-Pacific (FoodSTART+)

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Authors:

Gordon Prain and Diego Naziri

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Executive summary

The paper begins with a review of the literature on resilience, noting the wide diversity of perspectives on the term and the range of disciplines that have employed the concept. From its use to describe engineering systems that are close to equilibrium, the concept of resilience has evolved to characterize non-linear systems far from equilibrium in ecology and later, in social-ecological systems where resilience derives from the complex interactions of ecosystems and social systems. The paper then looks in some detail at the way the term resilience has been used more recently in relation to recovery from disaster and in assuring food and nutrition security. Drawing on this literature, and also on earlier food security work by the Food Security Through Asian Root and Tuber Crops project (FoodSTART), a provisional conceptual framework was proposed to help understand the relationship between shocks and stressors and the social-ecological system. For this review the latter is characterized as the agri-food system made up of interacting households with their food access, assets, knowledge and social capital and more or less diverse and robust agro-ecologies. Shocks and stresses can directly affect food security outcomes, such as through the destruction of crops. But responses coming from the agency of individuals, households and communities in the form of preparedness, coping, adaptation and transformation, can mitigate the negative food security outcomes.

In the light of the theoretical background and the proposed agri-food system resilience framework, the paper goes on to review literature on different agri-food systems in the Asian region. It identifies the key characteristics and vulnerabilities of these systems and the important functions of roots and tubers within them. The ubiquity of root and tuber crops (RTCs) among ethnic minorities practicing shifting agriculture throughout the tropical and sub-tropical hill areas of Asia because they are robust, can be continuously harvested and can be depended upon to contribute to household food and nutritional security. Roots and tubers, especially cassava and potato, also have played significant roles in the widespread transformation of shifting systems into more commercial, permanent field agriculture. Roots and tubers are also important rotation and relay crops in lowland agri-food systems in Asia, including in coastal areas, where they have been shown to have a role as 'secondary' relay crops with primary food and resilience-related functions. The planting of RTCs in these systems gives rise to their reputation as emergency food. They contribute to increased productivity of the systems through use of marginal spaces and reduced risk through their capacity to withstand weather extremes. Finally, RTCs play a key role in rural and urban homegardens, a distinct agri-food system that is widespread in the region.

This literature, which was analyzed through the lens of the agri-food system resilience framework, also provided evidence of the important contribution of roots and tubers to mitigating the effects of different kinds of climate change-related stressors and shocks and contributing to system adaptation. The paper also presents and discusses the specific characteristics and traits that make these crops particularly tolerant or resistant to shocks and stressors (especially abiotic stressors like heat, drought, soil salinity and water-logging and shocks like typhoons/cyclones) and important contributors to post-disaster recovery (for instance, due to the possibility of piecemeal harvesting and their short growing cycles).

In order to validate the findings from the literature review about Asian agri-food system resilience and the role of roots and tubers within it, a ground-truthing was conducted through field studies in Northeast India and in central Philippines. This provided access to the voices of women and men who faced different types of shocks and stressors and allowed a better understanding about how they responded, including the role played by RTCs in their responses to the adverse events. It was possible to go beyond homogenous household and

community responses to shocks and stressors through differentiating perceptions in terms of genders and socio-economic status. Whilst those who were better off were often more prepared and more able to respond because of greater asset endowment, some kinds of stressors, such as livestock diseases in East Khasi Hills, affected the better off more severely. The paper presents f examples of adaptation and even transformation occurring among households with different socio-economic status. Prompted by the literature survey, women and men were also asked about subjective resilience, the individuals' self-perceptions about their ability to 'bounce back' or 'bounce forward' and conversely people's loss of hope and feeling of incapacity. There was evidence of strong positivity among some women's groups in the face of stressors and shocks and a determination to "fight back with all their strength". This included a determination and confidence to find ways to reestablish agriculture by striving to obtain seeds. The importance of reestablishing access to seed through any means available confirmed the commonly identified importance in the literature of seed as a means for supporting longer-term recovery after shocks and stresses.

It was not always easy to differentiate between types of agency deployed in response to crises, in other words between coping and adaptation and transformation. The case studies also showed differences in responses both within the environments selected and also between them, especially in terms of the level of post-disaster assistance received and the self-characterization of responses by different socio-economic groups.

Discussions with the farming households involved in the field study supported conclusions from both the agro-ecosystem and the technical literature regarding root and tuber crops. They were reported to play a key role in both highland mixed systems and coastal systems in Asia, agri-food systems which are among the most vulnerable to climate change. In summary, these crops contribute to the robustness and diversity of agro-ecologies and strengthen preparedness, coping and adaptation strategies of households.

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1. Introduction

In recognition of the important contribution that root and tuber crops (RTCs) can make to food security in Asia, in 2010 the International Fund for Agricultural Development (IFAD) invited the International Potato Center (CIP) to develop a research proposal. The purpose was to assess and promote the role of RTCs in the farming systems of the Asia-Pacific region to “build a more diverse and robust regional food system in the face of possible shocks and climate change” (CIP 2010: p5). CIP undertook this work through partnerships with national agricultural research institutes in the region and with IFAD investment projects in selected countries. The project Food Security Through Asian Root and Tuber Crops (hereinafter referred to as FoodSTART) included an objective to understand and document current roles of RTCs in contributing to food security, including through increased income generation.

To systematically approach this objective, the FoodSTART team developed a food security conceptual framework (Campilan et al. 2014). This framework considered the four dimensions of food security: availability, access, utilization and stability, as set out in the FAO definition (FAO 2008), although in the FoodSTART framework the term ‘stability’ was replaced by ‘vulnerability’ (see below). In undertaking general assessments of the contribution of RTCs to food security and in the follow up thematic studies, the project focused primarily on the contribution of RTCs to increasing overall **food availability**, whether RTCs offered producers greater **food access** and then on the **extent of utilization** of RTCs in terms of consumption and nutritional benefits, also taking into consideration the cultural patterns of food preparation. Less attention was paid to the fourth, dynamic aspect of food security, **food stability or vulnerability**. Part of the difficulty with the concept of food stability, as set out in the food security definition of FAO, is its historical baggage, especially its association with ensuring global availability of food and to minimize fluctuations in food supplies (Løvendal et al. 2004). More recently, there has been a conceptual cloudiness in its association with food vulnerability – a concern with the actual or future lack of access to food leading to food insecurity – and with food resilience – at least part of which involves the maintenance of food security over time, or the capacity to return to a stable state of food security after perturbation¹. Another difficulty is that whereas food availability, access and utilization can be studied as outcomes at a particular point in time and thus were readily accommodated within the mostly synchronic focus of the assessments and thematic studies of FoodSTART phase 1, it was more difficult to examine food stability or vulnerability over time.

The second phase of FoodSTART (Food Resilience Through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific or FoodSTART+) sought to target food stability head-on through its overall purpose to promote the role of RTCs in reducing food vulnerability and enhancing resilience of poor male and female agricultural producers and consumers in the Asia-Pacific. Given the increased threat in the region from a range of external environmental, biophysical and socio-economic risks and shocks, including typhoons/cyclones, flooding, landslides and increasing incidence of pest and disease attack, as well as financial and political crises, an urgent need was identified to determine how RTCs can contribute to more stable food security over time through adaptive management strategies for enhancing food resilience.

Following scoping studies conducted with partner IFAD investment projects in the selected FoodSTART+ sites, intervention activities were identified and implemented to strengthen the role of RTCs both as food and source of income in the different sites. However, there was no systematic understanding about the

¹ These are provisional glosses for terms which are notoriously difficult to define (Amaya and Prain 2016). The paper returns to the issue of definitions at a later point.

contribution of RTCs to food resilience, defined in the original FoodSTART+ proposal as “a measure of the ability of households and communities to maintain existing stability of food supply and use, or adapt to a new situation (of supply and use), without undergoing catastrophic changes in their basic functioning” (Pingali et al. 2005). Evidence of the contribution of RTCs to food resilience across the intervention sites would only be available through an ex-post impact assessment of the interventions after the end of the project. Yet the expectation that RTCs can enhance food resilience is built into the whole FoodSTART+ project, so it is important to provide a body of evidence for the role of RTCs in food resilience during the current project and ahead of a possible ex-post assessment. A literature review was therefore undertaken on food resilience in the Asia region to identify existing evidence of the contribution of different crops, with an emphasis on RTCs.

This paper builds on an earlier literature review conducted in the framework of FoodSTART+ which primarily examined the way the concept of vulnerability has been used in a number of different academic and practitioner fields, including in relation to food security. It also briefly reviewed the use of the related concept of resilience (Amaya and Prain 2016). The main conclusions of the paper were as follows:

- Rapid uptake of the resilience concept can be appreciated in humanitarian and social development fields.
- Most studies of vulnerability focus more on poverty than food insecurity.
- Resilience is a newer concept in the context of food security and nutrition with concerns about combining reliable metrics with contextual sensitivity, including intra-household and gender relations.
- There is no consensus on definitions, thresholds and metrics (“vulnerability refers to people’s propensity to fall, or stay, below a food security threshold” but no standard is available to define the threshold and, hence, to measure vulnerability).
- Most food vulnerability indicators are household based. There is need for intra-household indicators too, to capture important gender and age-related variability in vulnerability.
- Conceptual and empirical difficulties with food vulnerability include:
 - Vulnerability characterized in relation to unknown and unpredictable future shocks
 - Vulnerability treated as an outcome rather than being predictive (current level of exposure to future stresses and shocks)
 - Lack of empirical cases.

The present study will not go over the same ground as that review but will concentrate specifically on resilience and not engage with the considerable literature on the relationship between resilience and vulnerability. It will focus on the agricultural context, as far as possible on the Asian region, though review of selective literature on the theoretical foundations of food-related resilience, while that related to the agronomic and other properties of RTCs themselves will not be region-specific. To ground-truth both the agronomic claims and the theoretical interpretations, this study included brief field studies conducted with women and men in two of the key sites of FoodSTART+, in Meghalaya in Northeast India and in central Philippines.

In the FoodSTART+ proposal and also in much of the reporting and discussions, the term ‘food resilience’ has been used for the desired interpretation of the fourth dimension of food security. Neither in the FoodSTART+ proposal nor subsequently has the project examined the relationship between the FAO term for the fourth dimension of food security, stability, and FoodSTART+ preferred term resilience. The FAO term has been the least elaborated of the widely applied four dimensions of food security. Historically, stability has been most closely associated with forecasting possible supply shocks. It has been strongly related to availability of food rather than

to access or utilization (Løvendal et al. 2004). In that context, stability is about a return to the earlier state (equilibrium). As will be discussed in more detail in Section 3, one interpretation of resilience, linked to engineering and a particular use in ecology, follows the same meaning, but more recent interpretations include the possibility of moving to a new state, of not necessarily bouncing back, but sometimes bouncing forward (Manyena et al. 2011). In this sense the definition used in the FoodSTART+ proposal, taken from Pingali et al. (2005), was highly relevant: it incorporates the idea not only of maintaining existing stability of food supply and use, but in some cases “adapting to a new situation (of food supply and use)”.

The other important element of the Pingali definition is its focus on systems. This seems to be an important improvement on the notion of food resilience for two reasons. First, food is produced within an agricultural system which itself is part of an ecosystem. Several scholars have argued that in people-centered uses of the term resilience, especially in literature dealing with relocalization of food and issues of food sovereignty, there is a limited attention to ecosystems and agriculture (Lamine 2015). Second, the same author also points out that in the environmental literature there is a limited focus on people and their food access and utilization. In this review it is proposed to shift the attention to the resilience of agri-food systems (AFS) which accommodates both sets of concerns and facilitates the potential of a resilience focus to provide a cross-sectoral perspective (Bene et al. 2012).

After presenting the methodology in the following section, Section 3 reviews selected literature on the concept of resilience, especially in the disaster and food and nutrition security literature. Based on that literature and on FoodSTART’s own experience, a conceptual framework is proposed for AFS resilience within which the role of RTCs can be considered. Section 4 reviews literature on key agro-ecologies in Asia and the role of RTCs in the food-focused social-ecological systems associated with those ecologies. Section 5 then reviews some of the technical literature on RTCs to understand their potential role as part of the response component of the conceptual framework. The framework also helps to structure the ground-truthing field exercises in India and Philippines presented in Section 6. The last section presents the main conclusions and implications of the study.

2. Methodology

The topic of resilience has become of huge interest across many fields. A Google search using just that single term yielded 192 million hits. A search on Google Scholar yielded 2.25 million hits. Even a search on Google Scholar using the terms resilience AND agriculture yielded 850,000 hits. As Alexander (2013) observes, in her history of the use and meaning of the term resilience, it is becoming increasingly difficult to summarize the field. This review is therefore necessarily partial and narrative. It has proceeded primarily using combinations of keywords and snowballing from bibliographies of selected articles.

Section 3 was guided by identification of literature through a combination of keywords that drew in the food and nutrition, disaster and governance literature linked to resilience. Known texts were mined for additional literature, especially literature reviews. During the review, there was some limited consultation with researchers involved in the CGIAR Research Program on Roots, Tubers and Bananas (RTB). Keywords used are listed in Annex 1.

For Section 4, with its regional focus, region and country keywords were used, combined with terms for target agricultural systems and agricultural environments. This section also relied on known texts, especially literature reviews and their bibliographies to expand the range of references.

For section 5, the search has focused on the large bio-physical literature concerned with the performance of particular RTCs under different kinds of stressors and efforts to increase their level of resilience or tolerance vis-à-vis these stressors. There is considerable variation in the volume of research devoted to different RTCs. Not surprisingly the most researched is potato given its importance across temperate, sub-tropical and highland tropical environments, and its importance in the economies of the Global North. A search of Google Scholar for 'potato', that used advance search tools to eliminate ambiguity with sweetpotato, identified 139,000 hits with potato in the title and 1.9 million hits with potato referred to anywhere in the article. The next most commonly occurring was 'cassava', with 70,590 hits for the title and 687,000 hits for any occurrence in the article². The term 'sweetpotato', with avoidance of confusion with potato, returned 21,900 hits for the title and 915,000 for any occurrence in the article. Other RTCs yielded far fewer hits. 'Yam', which includes 12 edible species of *Dioscorea* only some of which are relevant for Asia, produced 10,800 hits in all for occurrence in the title and 541,000 hits for occurrence in the article. These results may have been inflated with some articles referring to other species for which the term 'yam' is applied in local usage – for example, oca in New Zealand and sweetpotato in the southern USA. To gauge better the importance of yam research in the Asian context, the term '*Dioscorea*' was used together with occurrence of terms '*alata*' and '*esculenta*' which are the two species common in Asia, and exclusion of the term '*rotundata*', the most common species grown in West Africa. This yielded 1,740 hits with the term in the title and 22,600 anywhere in the article. Finally, the terms 'taro' or '*Colocasia*' returned 1,500 hits in the title of articles and 19,000 for occurrences in the article. There is of course an enormous mix of research issues addressed in these articles generated by the RTC terms. This report only considers a tiny fraction of these articles and focuses primarily on tolerance to abiotic stressors with occasional reference to biotic stressors of particular RTC species where these are related to increased

² These totals also include the term 'yuca', the Spanish for cassava, given the importance of research on the crop in Latin America and its frequent application in Asia. The scientific term for the crop, *Manihot esculenta*, returned only 9,300 hits for occurrence in the title of articles.

pest and disease pressure in new areas caused by climate change. More refined searches combined the crop with particular stressors.

The methods used in the ground-truthing field studies presented in Section 6 were adapted from Petesch et al. (2018b). Single-sex FGDs were held in two locations in Meghalaya State, Northeast India and in two locations in central Philippines. The guide questions for the FGDs were developed based on the AFS resilience conceptual framework and key themes and issues raised in the literature. The ladder of life tool is taken from Petesch et al. (2018b).

3. Selective theoretical literature on resilience

A key question posed by Melissa Leach (2008) in relation to any discussion of resilience was: “**resilience of what, for whom?**” This question was raised in Section 1 of this paper in relation to the orientation of the review. It was argued that the major focus of FoodSTART has been on food security (Phase 1) and food resilience (Phase 2). However, the interdependence of human-focused food utilization and ecologically-grounded food production and the different ways both are vulnerable to climate change suggests that we should be focused on AFS resilience as a more encompassing approach to understanding resilience. Food is one of the key connectors between people and the environment, between the social and the ecological spheres. With this focus, a broad definition of resilience was provided as a heuristic in Section 1 for initial orientation of the paper. This section examines the theoretical literature on resilience and in so doing revisits the definition and interrogates further the validity of the AFS approach.

3.1. The diversity of resilience literature

The literature on resilience shows a wide diversity of perspectives with distinct disciplines developing their own definitions, none of which command universal agreement (Martin-Breen and Anderies 2011; Amaya and Prain 2018). The term has a long history in literature and the arts, but according to Alexander (2013), appears to have been first used scientifically in 19th century mechanics, when it was used to describe two qualities of steel: rigidity to resist the application of a force but also ductility or flexibility in becoming somewhat deformed and returning to its original shape. C.S. Holling (1973) is credited with the first systematic elaboration of the term as a scientific concept in ecology, which he defined as: “a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables”. This has been followed by a large number of authors (cf. Standish et al. 2014) with refined or significantly different definitions and understandings of the term.

Although some similar concepts were included in the ecological paradigm of resilience as were used in mechanics – versions of rigidity and ductility for example (Walker et al. 2004) – a conceptual dichotomy nevertheless emerged between ‘engineering resilience’ and ‘ecological resilience’. Holling (1996) characterizes these as respectively a concern with stability around an equilibrium steady state with resistance to disturbance and speed of return to the equilibrium as the key variables and alternatively, a focus on conditions far from an equilibrium steady state, where instabilities can fundamentally change the system into a different stability condition and where the key variable is the magnitude of disturbance that a system can absorb before changing its structure.

In response to the question of resilience of what, for whom? the answer from engineering seems to be of materials, for engineers and their clients. The answer from ecology seems to be of ecological systems or sub-systems, for the managers of those systems. In the paper by Walker et al. (2004), with Holling as one of the co-authors, management is envisaged as the social part of social-ecological systems (SEs). The authors argue that such systems consist of three complementary attributes: **resilience**, **adaptability** and **transformability**, with resilience being composed of a sub-set of aspects: ‘latitude’, or the maximum amount a system can be changed before losing its ability to recover, which is similar to the notion of ductility in the engineering literature; ‘resistance’ which is the ease or difficulty of changing the system, which is similar to the notion of rigidity in the engineering literature; precariousness, referring to how close the current state of the system is to a limit or threshold (or tipping point); and panarchy, which refers to the cross-scale interactions which can

positively or negatively affect resilience (slow-changing – declining and/or expanding – fallow periods in communal fallow systems and more rapidly changing, household-driven crop combinations in swidden farms³ for example). Adaptability is “the capacity of actors in a system to influence resilience” (ibid: p3). Adaptive capacity is clearly a key component of SESs, but this study seems to be suggesting that human actors are not part of system resilience, but act on it. Transformability is “the capacity to create a fundamentally new system” when ecological and/or socio-economic and/or political conditions make the existing system untenable (ibid.). The idea that human capabilities, cultural preconceptions or agency are integral parts of resilience processes does not seem to be envisaged within this approach (cf. Bene et al. 2012).

The complex and unresolved relationship between ecological and social science applications of resilience theory was a key driver for the establishment in the 1990s of the Resilience Alliance in Stockholm (Cote and Nightingale 2012). Cote and Nightingale discuss the efforts of Resilience Alliance participants to more clearly frame the coupling of social and ecological components in a complex resilient system, in contrast to some of the ecological literature where social actors are conceived as just acting on resilience. The diversity of opinions and the different framings of resilience thinking are clearly evident in a symposium on Re-framing Resilience, held in the Institute of Development Studies STEPS Centre in 2008 (Leach 2008). The symposium explicitly sought to explore the relevance of resilience for issues of social justice and poverty alleviation and the ability of the concept to address social and political power, and the agency of social actors, which introduced a more normative understanding of resilience (Leach 2008). The poverty neutrality of many framings of resilience (Bene et al. 2016) will be discussed in the following sub-sections.

One of the key positive aspects of resilience is its cross-disciplinary and cross-sectoral eclecticism, making it a useful conceptual tool for addressing the effects of stressors and shocks on complex natural and social systems and their capacity to continue contributing to sustainable livelihoods (Leach 2008; Bene et al. 2012; Hoddintott 2014; Lamine 2015). In view of the focus of this review, the following sub-sections look briefly at literature in relation to disaster intervention and recovery, literature related to food and nutrition security and finally at efforts to operationalize the concept by drawing on social science and ecological concepts to identify how human agency contributes to resilience processes.

3.2. Resilience in disaster contexts

Our interest in the role of RTCs in AFS resilience includes both response to stressors over the longer term, related for example to ecological or economic factors and the short-term emergency and recovery responses to shocks. These include extreme natural phenomena that may or may not be linked to climate change, like earthquakes, typhoons, floods and storm surges, and also socio-economic shocks, like price collapses or civil conflict. Literature reviews and papers dealing with disaster interventions address different kinds of recovery, though understandably with a stronger focus on emergency aid. The literature shows that until recently, vulnerability has been a key concept for practitioners and scholars of disaster response (Office of the United Nations Disaster Relief Co-ordinator 1980; Dilley and Boudreau 2001; Manyena 2006; Amaya and Prain 2017). Perhaps in response to the growing importance of the resilience concept across multiple disciplines and sectors, the International Federation of Red Cross and Red Crescent Societies tried to reorient their approach from vulnerability assessments and mitigation, to resilience and adaptation in 2004 (International Federation of Red Cross and Red Crescent Societies 2004).

³ Also known as shifting cultivation. See Section 4.

Manyena (2006) also draws attention to the earlier focus on vulnerability and the need for a shift in the disaster risk reduction work culture to take on board a resilience approach. But he identifies the changing definitions of resilience as a potential challenge in this transformation, especially the understanding of resilience on the one hand as an outcome and on the other as a dynamic process, an issue that also characterized the diverse uses of vulnerability (Dilley and Boudreau 2001). Reviewing a range of literature relevant to disaster management, Manyena notes a shift from an earlier focus on resilience as a desired outcome, towards resilience as a process and identifies some problems with the former conceptualization, and some advantages of the latter understanding. Seen as an outcome, resilience tends to reinforce paternalistic, reactive responses of traditional disaster management which is more supply than demand driven. It also favors adopting a command and control approach aimed at reestablishing the status quo and downplaying community capacity-building and disaster preparedness training. On the other hand, resilience conceptualized as a dynamic process emphasizes the human side, in particular the element of adaptation and strengthening the adaptive capacity of households, communities and countries to achieve desired outcomes and mitigate the damage from future disasters. In this interpretation, the writer sees resilience as more than coping, which was a strong focus of earlier efforts to reduce vulnerability. Resilience as a process that includes, but goes beyond, coping will be discussed in greater detail in Section 3.4.

The response of this literature to the question posed by Leach (2008) about “resilience of what, for whom?”, is mixed. In the older literature identified by Manyena (2006), resilience “of what” seems to relate to the ability of households, communities and countries to bounce back to their former condition following acute crises. The answer to the question “for whom?” seems to be for themselves, but also for the benefit of the country stability, the international community and order, the community of nations. For the more recent disaster and emergencies literature, such as Manyena et al. (2011), resilience is more identified as a property of the local system, including capabilities of local actors to introduce system changes.

The characteristics of resilience highlighted in the disaster literature concern the capabilities of households and communities to be prepared for and respond to immediate threats to survival. But after short-term survival comes longer-term individual, household and community security. This includes personal security in conflict situations and disasters like floods and earthquakes, but also includes food security. The World Food Program (WFP) has been strongly associated with relief operations in the past, but it is now increasingly engaged with longer-term recovery and development interventions (World Food Program 2018a). In Bangladesh the WFP initiated a new project to simultaneously address disaster preparedness and food and nutrition insecurity with resilience as a key component of the strategy (World Food Program 2018b).

Pingali et al. (2005), writing in the journal *Disasters* as director and members of the Agricultural and Development Economics Division of FAO, point out that most emergencies have an acute crisis phase requiring emergency assistance, but also a protracted crisis period requiring recovery and rebuilding. To ensure food security during the acute and protracted crisis, they argue for a focus on enhancing resilient food systems. In this context, Pingali et al. (2005) interpret resilience “as a measure of the ability of a system to remain stable or to adapt to a new situation without undergoing catastrophic changes in its basic functioning” (ibid: p14). This approach has several important elements. It focuses attention on the resilience of a system rather than an individual or a household. It recognizes that there can be a bouncing forward through structural change brought about by adaptation, not just a bouncing back to the previous status quo. It also recognizes that the basic functioning of the system – the provision of food security – needs to be preserved. The principles these authors identify as key to resilience echo other writers in some respects, but also go further:

- Strengthening diversity
- Rebuilding local institutions and traditional support networks
- Reinforcing local knowledge
- Building on farmers' ability to adapt and reorganize.

Besides a focus on food systems and food security and diversification of livelihoods, this approach also underlines the importance of institutions, governance and local social capital and the need for fostering and building on local knowledge, expertise and capacity to adapt. It hints at but does not fully articulate the idea of 'subjective resilience', people's perceptions about their ability to cope, adapt or transform their circumstances in the face of shocks or stresses (Jones and Tanner 2015). This concept has been underexplored in the resilience literature and this paper will return to it in section 3.4. The following sub-section looks in some more detail at the relevance of the concept of resilience for food and nutrition security.

3.3. Application of the concept of resilience to food and nutrition security

In a compendium of papers published by the International Food Policy Research Institute (IFPRI), *Resilience in Food and Nutrition Security* (Fan et al. 2014a), the editors concur with other writers cited that resilience offers a means to link short-term humanitarian efforts with longer term development activities (Fan et al. 2014b). The book's major focus is on the opportunity offered by the resilience framework to enable "a systems-oriented way of coping with shocks, which disproportionately affect the world's poorest and most vulnerable people" (ibid: p1). The editors understand building resilience as a means of "helping people, communities, countries and global institutions prevent, anticipate, prepare for, cope with and recover from shocks and not only bounce back to where they were before the shocks occurred, but become even better off" (ibid: p4). This definition is understood "against the backdrop of food and nutrition security" as that is the focus of the book. They suggest that food and nutrition security is both an outcome of resilient processes, but also a contributing factor to resilience. This underlines the understanding of resilience as a process with positive feedback loops – for example, successful agricultural adaptation increasing production of nutritious crops and animal source foods – which strengthens resilience, or potential negative feedback reducing resilience - for example where coping strategies focus on leveraging short-term emergency payments at the expense of agricultural recovery.

Among a number of thematic chapters in the volume, Hoddinott (2014) looks at development through a resilience lens, concurs with many writers already cited that resilience can be seen as a means to break down the silos of humanitarian emergencies, governance, food and nutrition security, and economic development, and recommends joining up these activities in a systematic approach. Drawing on a number of common elements identified in the literature, he cites the following definition: "Resilience is the capacity that ensures adverse stressors and shocks do not have **long-lasting adverse development consequences**" (emphasis added). Hoddinott identifies a number of common elements in several resilience frameworks: the context within which households or other units operate; their resource endowment; their deployment of those resources and how economic returns from resource deployment are affected by shocks; and finally, how economic outcomes from normal or shock-affected resource use leads to different types of food consumption, other types of consumption, savings, health and nutrition. This broad resilience framework is used to construct different hypothetical household circumstances in relation to a food consumption score (FCS), which is a composite score based on dietary diversity, food frequency and relative nutritional importance of different food groups (World Food Program 2008). The FCS provides information on an initial level (dark squares in Figure 1a) and range or variability in the responses. Based on this measure some households have an initial

score above a minimum level of FCS (households A, C, E, F) but with variability that includes food insecurity (all except F), while two (B and D) are initially food insecure. When a shock strikes, it affects these households differently, depending on the different resources and contexts, as reflected in the variability (Figure 1b). Similarly, recovery is also variable (Figure 1c), with some households showing levels of resilience to return to the initial state (bounce back) but still food insecure (D), some resilient enough to improve their after-shock situations, but not to their original state and so remaining more seriously food insecure (B), one household pushed into food insecurity by the shock and though improving their after-shock situation, still remaining food insecure after recovery (C). Household (E) shows no resilience, whereas households A and F have levels of resilience allowing them to bounce forward – in one case after having become food insecure in the after-shock circumstances– to an even stronger food secure situation.

Figures 1a-1c. Potential variability of food security (FS) outcomes depending on initial conditions and capacity for recovery

Figure 1a. Initial states and range of FS of six households

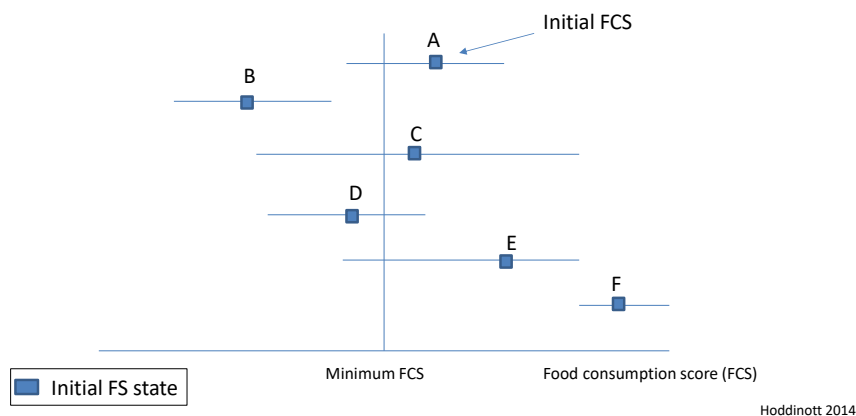


Figure 1b. Immediate food security impacts on six households following an adverse shock

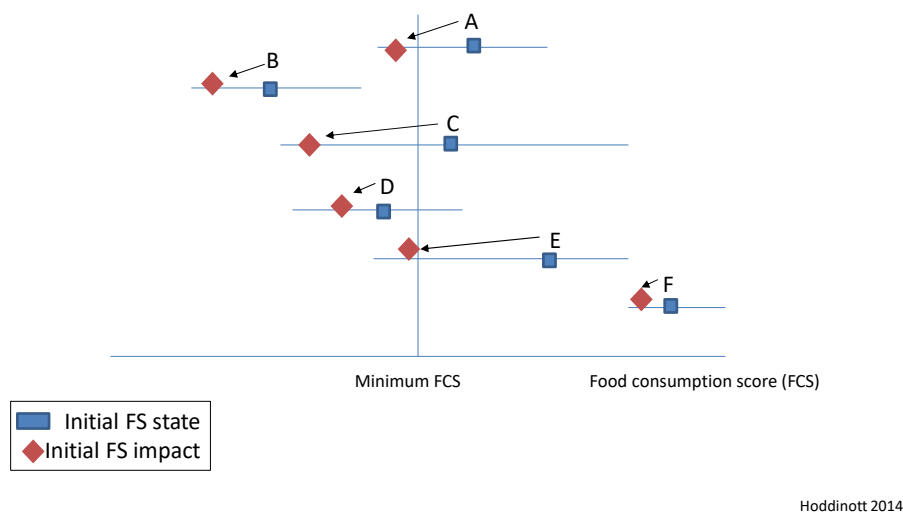
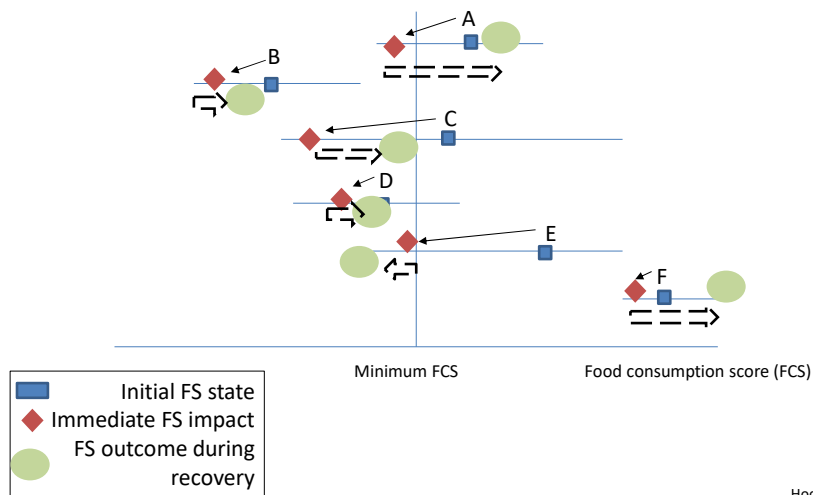


Figure 1c Food security outcomes of six households during recovery



This exercise shows both how important are the combinations of initial conditions (context, assets, income, etc.) that affect responses to shocks, but also, how important and variable are resilience capacities, which include preparedness (what Hoddinott calls *ex ante* or pre-shock capacity) and the *ex post* capacities, especially in terms of the time path of recovery. Preparedness is often measured in terms of assets, livelihood activities and outcomes, but the author also raises the point made earlier that subjective assessments of resilience are also an important measure.

In the same volume, the chapter by Dufur et al. (2014) again emphasizes that nutrition is both an input to and an output of resilience. It identifies common elements between resilience and nutrition, both being context-dependent and both relying on a systematic approach involving cross-sectoral linkages, multi-stakeholder involvement and relevance at multiple scales. They note that in relation to the multi-scale aspects of the two fields, resilience approaches usually stop at household level. For nutritional concerns, there is a need to consider the individual level or, as they put it, to “analyze the food system in terms of its ability to provide the right food at the right time to the right individuals” (ibid: p111) (see also Leach 2008; Kumar and Quisumbing 2014; Lamine 2015). They also emphasize applying a nutrition lens to the different resilience capacities, including coping (absorptive capacity with limited negative nutrition implications), adaptive capacity (accessing nutritional foods from more reliable, more climate-smart sources) and transformative capacity (changing the sources and varieties of food consumed that lead to positive nutritional benefits). The nutritional dimensions of these three types of resilience-related capacity are discussed further below. Finally, Dufur et al. (2014) also emphasize the importance of issues of governance for resilience and nutrition, echoing Pingali et al. (2005), Hoddinott (2014) and others, especially the need for local buy-in/ownership and political leadership.

The chapter in the same volume by Kumar and Quisumbing (2014) provides an important gender lens on resilience in the context of food and nutrition security. They underline the limited awareness about differential vulnerabilities between men and women in low-income households. Men and women face different kinds and intensities of risk and capacities to cope with risk because of biological, economic and socio-cultural differences, including through gender norms (cf. Badstue et al. 2018). A key difference affecting both vulnerability and coping relates to the fact that women often have less access to and control over resources than men and are often exposed to gender-based challenges such as workload, fewer legal protections and domestic violence. During crises women tend more easily to lose the assets and employment positions they do have, and they can also expect their workload to significantly increase. A survey of natural disasters in 141

countries between 1981 and 2002 found that women's life expectancy decreased to a greater extent than men (Neumayer and Plümpert 2007, cited in Kumar and Quisumbing 2014). In their analysis of gender-based differences in resilience strategies and behavior, Kumar and Quisumbing focus on preparedness (referred to as *ex ante* coping) and what they call *ex post* coping. Among *ex post* coping behavior, they identify adjustments in consumption patterns, where women have been shown to absorb a disproportionate burden, both in their own cut-backs on quality and quantity of food, and the effects suffered during pregnancy and lactation. In places like Bangladesh cultural factors restrict the options of women to seek ways to supplement family income during crises. When women can enter the labor market, they are likely to receive less pay for the same job as men, the nutritional status of younger children can suffer, and the developmental opportunities of adolescent girls can be affected as they assume caregiver roles. Virilocal marriage arrangements in many parts of Asia mean that young brides move to their husband's family location. This can exacerbate the burdens on a recently married woman imposed by her parents-in-law, especially so in times of crisis, but it can also contribute to household resilience through the social capital and mutual help built between the groom's family in one location and the bride's family elsewhere (the importance of this marriage-based social capital in times of crises is reported in Section 6).

The general importance of asset accumulation to buffer against future shocks as a part of *ex ante* coping is also gendered. Kumar and Quisumbing (2014) point to the greater challenge women face in acquiring assets and the fact that those they do acquire tend to be more liquid than men's, such as jewelry or small livestock. These are precisely the assets that are most easily cashed in when the household needs food and other emergency goods and services at times of a crisis. Women's agricultural activities, including raising small livestock and small-scale vegetable production in homegardens, are also part of household *ex post* coping (Dufour et al. 2014; Prinzo and Benoist 2002).

As discussed in Section 1, the concept of agri-food systems strengthens understanding of the resilience implications of cross-cutting and cross-sectoral linkages involving agriculture, food, nutrition and gender, but also the environmental factors which were not directly raised in the papers reviewed in this sub-section. Lamine (2014) addresses the use of AFSs to reconnect agriculture, food and the environment in the context of sustainability and resilience. The paper considers two dominant paradigms in addressing AFS resilience: the sustainable development paradigm which, she argues, privileges attention to the relationship between agriculture and the environment at the expense of food and diets, and the relocalization paradigm, which privileges alternative food systems, food justice and social movements around food and diets, with less attention to the environment. The paper seeks to draw on both paradigms to develop a vision of territorially-based AFSs embedded in specific environments – a vision which this paper also adopts in Section 4 – but which also considers the relevance of producer-consumer interactions and trust and the growing importance of 'healthy food'⁴. This is certainly relevant for the changing perceptions about roots and tubers in Asia, from purple sweetpotatoes for the East Asia markets to taro chips for Japan.

3.4. Towards an agri-food system resilience framework

Based on the literature reviewed, resilience in the context of food security is understood as a characteristic or property of dynamic agri-food systems. It involves different dimensions before (preparedness) and after the occurrence of shocks (coping, adaptation and transformation), and these dimensions are also relevant for dealing with longer-term stresses. A resilience perspective helps to strengthen cross-sectoral collaboration and

⁴ This refers not just to nutritional content, but also to conditions of production, reputation and non-nutritional health properties.

communication, and, in the context of the agri-food system, resilience occurs at different scales, including individuals, households, communities and higher level governance structures. Many scholars emphasize the importance of assets as a measure of resilience, but several of them also stress the importance of subjective resilience.

This final sub-section draws on some additional literature mainly associated with the work of Chris Bene and colleagues to clarify some of these points, raise some concerns about the limitations of the concept of resilience, and seek to identify an AFS resilience framework that has operational value.

Bene et al. (2012) also emphasize the benefit of a resilience perspective fostering cross-sectoral understanding and communication. This is a dry-sounding phrase which these authors seek to bring to life by suggesting that different actors can “sit down and work together based on the intuitive and relatively loose meaning of resilience” (ibid: p12). In other words, it can facilitate real partnerships between, say, research teams and large development projects of the type promoted by FoodSTART+. They also emphasize, as do other authors, the importance of the systematic approach that resilience entails, with processes and dynamics affecting people and their natural and physical environments at multiple levels. Bene et al. concur with other authors mentioned earlier in considering resilience not as an outcome of different kinds of interventions, which can be measured, but as an ability. This seems appropriate for individuals or social groups, but based on other literature previously cited, when considering the resilience of systems such as households, communities and regions, it seems better to look at the resilience properties of different system levels. These authors also highlight several limitations they see with the concept. They raise an aspect which recurs in other literature, that the history of resilience, especially its association with engineering and ecology, makes it unable, in the opinion of many social scientists, to “appropriately capture and reflect social dynamics...and issues of agency and power” (ibid). An over-focus on the resilience of ‘the system’ obscures the actions and power plays of individuals within the system. This recalls the questions posed by Leach (2008): “resilience of what, for whom?”. If resilience is about the system and is for the benefit of the community, then gender and socio-economic inequalities and power issues can be obscured or ignored. The solution provided by Leach is to adopt a normative approach to resilience, contributing to ‘the system’ not only the capacity for recovery but also a contribution to poverty reduction and greater social justice, the bouncing forward of the most vulnerable members of affected communities. This resonates with the call by Fan and colleagues that resilience involves women and men not only bouncing back to “where they were before...but (to) become even better off” (Fen et al. 2014b), economically, in terms of gender and in terms of inclusion (Kumar and Quisumbing 2014)⁵. These authors argue for the need to look at the individual level in resilience approaches to understand potential trade-offs between men and women’s resilience strategies. This can also affect uptake of RTCs by women in some contexts, such as Bangladesh, where women may opt to intensify their planting of RTCs in homestead gardens in response to stressors and shocks, but husbands may prefer that women use their labor in other ways as a response to shocks.

Keeping in mind these limitations, Bene et al. (2012) discuss a three-dimensional (3-D) resilience framework, key elements of which were first introduced by Holling (1973). From the early, unidimensional engineering view of resilience involving the capacity of a system to absorb disturbance and return to its original state, a three-dimensional system response involves three different capacities with different outcomes: **absorptive coping capacity** leading to a ‘persistence’ outcome; **adaptive capacity** involving ‘incremental adjustment’

⁵ A normative approach to resilience is not the same as the frequent tendency to assume that resilience is inherently “a good thing”, as Bene et al. point out (2012). There are many examples of resilience leading to negative social outcomes.

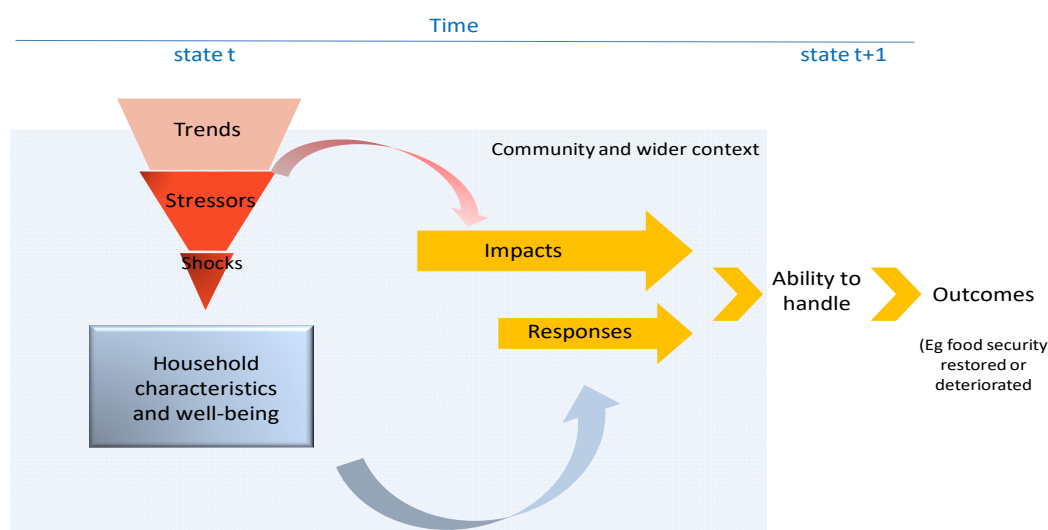
outcomes; and **transformative capacity** leading to ‘transformational responses’ or outcomes. The authors link these three capacities to different intensities of shocks, from absorbing lower level shocks, through adaptive responses like changes in farming practices/techniques or diversifying livelihood strategies, to transformative responses, like conversion of agricultural land or population resettlement. The framework clearly simplifies the variability of the initial conditions of different individuals and households involved in a particular system. As the discussion of the paper by Hoddinott (2014) indicated above, it seems possible that the resources and capacities of a household may limit it to coping strategies, however intense the shock. The valid question that Bene and colleagues ask is how to strengthen resilience so that when there is need for adaptation or transformation, individuals, households and communities have the necessary capacities.

There is undoubtedly a tension in the literature and in real-life situations between stability, the desire to return to a previous equilibrium, and change through adaptation, which needs flexibility. Flexibility is mentioned by Bene and colleagues as a key component of resilience and the authors note that some writers tend to consider stability in a negative light. Scoones for example, in the IDS Symposium on resilience, contrasts “conventional adaptation, with its focus on individual actors and narrow forms of stability and risk framing” with the “resilience approach (which) brings in cross-scale interactions, uncertainty and surprise” (Leach 2008: p6). Yet in the same volume, Leach argues that both stability and flexibility may be needed in a resilience approach that involves multiple types of shocks at different levels. Bene et al. (2012) make a similar point, recognizing that stability may also be important at some moments and in relation to some responses.

The 3-D framework is elaborated further in a later publication (Bene et al. 2016). The paper, which asks in the title whether resilience is socially constructed, seeks to understand individual and household factors which influence resilience and hypothesizes that these include, besides asset endowment and experience, what we have earlier referred to as subjective resilience, people’s perceptions about their ability to cope, adapt or transform their circumstances in the face of shocks or stresses (Jones and Tanner 2015). Bene et al. (2016) also hypothesize that social capital is critical for resilience. Findings from several case studies of fishing communities, including one in southern Vietnam, confirm the importance of wealth as contributing to recovery, but did not support the role of assets as systematically differentiating responses to shocks and stresses. The study assessed the contribution of social capital to resilience, with inconclusive results which call for further research. The findings from Vietnam found that most responses to shocks involved coping capacity, such as reducing food and other expenses. Bene et al. (2012) also found that individuals and households do not have a single response to a single dimension of a shock or stress. They deploy a portfolio of responses, mixing coping with adaptation, to different dimensions of the shock. The study also determined that persons with high subjective resilience engaged significantly more in adaptive responses than those with low subjective resilience who mostly deployed coping strategies. Self-perceptions about capacity for coping, adaptation and transformation are clearly an important part of overall resilience in the face of shocks and stresses.

Bene et al. (2016) used the 3-D framework as their key methodology for the paper (Figure 2), guiding the collection of household inventories of shocks and stressors, and household interviews about their impacts. It also guided socio-economic surveys on household characteristics and perceptions of shocks and stress, and their ability to handle them (subjective resilience). In the framework, the final outcomes are seen as resulting from the combination of the direct impacts of the shocks, in terms of destroyed natural, physical and financial assets, physical and mental injuries suffered by individuals, and the responses to the shocks and stresses deployed by individuals and households.

Figure 2. Analytical framework used for resilience analysis

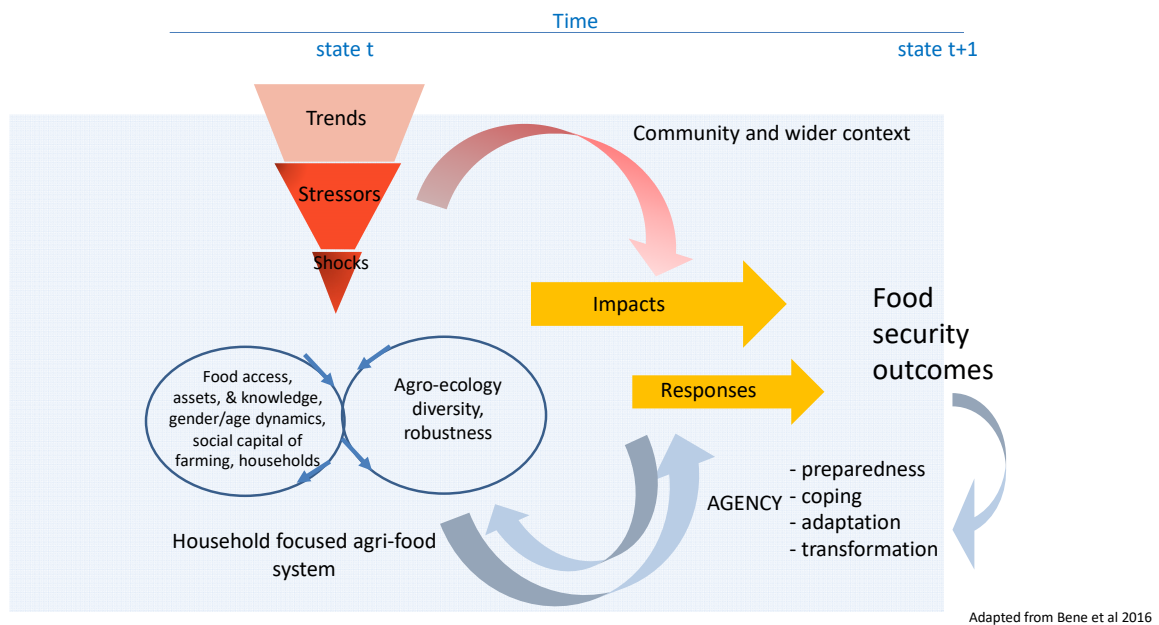


Bene et al 2016

The results of this review and earlier work by FoodSTART on food security (Campilan et al. 2014) suggest that the 3-D framework could be adapted to serve as a conceptual framework to guide our approach to AFS resilience (Figure 3). The framework considers the social-ecological system, discussed in the literature from a food and agriculture perspective, as an AFS. It proposes that the system consists of interlocking household and agro-ecology sub-systems. Key elements of the household sub-system involve food access (directly produced, purchased with available funds or received as transfer), different kinds of physical and financial assets, formal and local knowledge, gender and age dynamics within the household, and social capital, which may be at individual or at household levels, involving women’s and men’s joint social capital and/or individual social networks and support. The interconnected agro-ecology sub-system has many characteristics but, from the point of view of this framework, diversity and robustness are key elements. As was made clear in the food security framework that FoodSTART developed in 2012 (Campilan et al. 2014), issues of food availability, access, utilization and stability exist at scales beyond the household. Likewise, the AFS – as a special case of the social-ecological system – exists at different scales (Resilience Alliance 2010). In Figure 3 the community and higher scales of the AFS are graphically represented as the context in which the individual and households operate. Examples of the important interactions between these different scales will be presented in Section 6. As with the framework elaborated by Bene and colleagues, this framework seeks to capture the dynamics of this system caused by shocks, stressors, or even significant trends. These shocks and stressors have direct impacts that will influence food security outcomes irrespective of any human response – the destruction of infrastructure, natural habitats, crops and livestock for example. But mitigating those impacts are the responses coming from the changing AFS. The framework proposes that these changes come from the agency of households, communities and other levels of the AFS. Agency is a dense, multifaceted concept, which Naila Kabeer defines as “the ability to define one’s goals and act on them” (Kabeer 1999: p438). The notion of subjective resilience, discussed earlier in this section, is part of the ‘ability’ inherent in agency, encompassing the self-belief and determination to act on goals (cf. Badstue et al. 2018). We commonly think of agency in relation to individuals and especially in gender relations, but it is also a property of organizations such as associations or communities. Agency manifests itself in four different ways: through preparedness (being more or less ready to deal with the shock or stressor); coping (which from the household perspective is to survive

and seek stability, and from larger-scale agency to support survival and stability through food transfers, shelter and other means); adaptation (which involves finding new options for individual and household livelihoods, such as diversification of income or food production, possibly bouncing forward into a better situation); and transformation (which involves major shifts like exiting agriculture into local non-farm employment or migration). These responses affect food security outcomes, mitigating in small or major ways the direct impacts of the shocks or stressors.

Figure 3. Agri-food system resilience framework



4. Asian agri-food systems and the role of RTCs

The importance of RTCs for diverse populations and ecologies in Asia has been widely documented by anthropologists, ethnobotanists and other specialists (Yen 1974; Conklin 1975; Sillitoe 1983; Rhoades and Nazarea 1991; Prain et al. 2000; Onwueme 2002; Mathews 2004; Bourke and Harwood 2009; Wheatley 2010; Ellen and Soselisa 2012; Wheatley 2013; Anantharaman et al. 2016; Even et al. 2016; Koostanto et al. 2016; Roa et al. 2016). As these studies make clear, RTCs have contributed in different ways as staple or complementary food, economic resources and cultural signifiers to three major AFSs from the Himalayan foothills to the islands of the Asia-Pacific fringe. This section looks at their roles in these systems and Section 5 looks in more detail at the agronomic, post-harvest and nutritional characteristics of these crops that make them important contributors to the resilience of Asian AFSs.

4.1. Shifting or swidden agriculture

One of the earliest and most widespread AFSs in the tropical and sub-tropical hill areas of Asia is shifting or swidden agriculture. As the literature makes clear, in contrast to widespread myths about swidden agriculture – the pejorative term ‘slash and burn’ tends to underline the negative connotations – this is not one system, but more like a complex with hundreds of different permutations (Thrupp et al. 1997). The literature describes considerable variation across the Asian region in both space and over time, but also identifies three common elements: the removal of natural vegetation, often by cutting and then burning; the alternation between a short period of cultivation and a longer period of bush or forest fallow; and a cyclical shifting of fields, with a return to the same piece of land after several years (Erni 2015). One of the classic, most meticulous accounts of one version of the system was reported by Harold Conklin among the Hanunóo ethnic minority in the hill areas of Mindoro, Philippines during the 1950s (Conklin 1975). From that account a further common element can be identified: shifting cultivation mimics the natural ecology of forests by exploiting diversity of species across both horizontal and vertical space to ensure stability of production over time and reduce risk.

The association of this ancient AFS with an indigenous or ethnic minority population in Mindoro is another, very common element throughout the Asian region. These populations are disproportionately food insecure and impoverished: at the global scale, the approximately 370 million indigenous peoples represent 5% of the world population but 15% of the world’s poor and 33% of the extremely poor and food insecure (Erni 2015). A disaggregated figure for ethnic minorities involved in swidden agriculture in Asia is not available. Mertz et al. (2009) estimate that for Southeast Asia the figure is between 14 and 34 million. No such rough estimate is available for South Asia, but Erni concludes that there are several millions⁶.

4.1.1 Swidden agriculture in Northeast India and Eastern Indonesia

One concentration of ethnic minorities depending on shifting agriculture for their livelihoods in South Asia is in Northeast (NE) India, where a recent estimate puts the figure at around three million people (Patel et al. 2015). In the swidden or *jhum* cultivation in that region, RTCs are of major importance and it is probably one of several centers of domestication and diversity of taro (*Colocasia esculenta*) in the Indo-Pacific region (Mathews 2004; Rao et al. 2010; Blench 2013). The crop continues to play a key role in this AFS, both as food and feed. As

⁶ The difficulty of estimating the area of, and number of farmers involved in, swidden agriculture is considerable. The difficulty of estimating the coverage and production of specific crops within swidden systems is much greater and accounts for almost certain under-reporting of RTCs in the Asian region (Scott et al. 2000).

will be discussed in more detail in Section 6, which draws on the perceptions of farming households in Meghalaya State, the crop produces important quantities of food, withstands waterlogging during the frequent heavy rains that affect the region and can be readily marketed (Anantharaman et al. 2016). Cassava and sweetpotato are also planted along with taro in the jhum in Meghalaya, though RTCs tend to dominate in terms of frequency and coverage in mid- and higher elevation jhum rather than in the lower jhum (around 100 m a.s.l), where upland rice, maize and other cereals predominate. RTCs are also more common than other species in shorter cycle jhum (up to 5 years) (Ramakrishnan 1992). Ramakrishnan reports the reason for this as due to the slower recovery of fertility at higher altitudes, the rapid depletion of fertility in shorter cycles and the greater capacity of RTCs to respond to this situation. The capacity of these crops to withstand drought stress also enables farmers in these systems to plant RTCs before the onset of rains, once the jhum has been cleared by about March (ibid: p20). This in turns facilitates the earlier availability of food in early July, first from sweetpotato and then from the other RTCs.

Clearly shifting cultivation as an AFS and the roles of RTCs within it are complex and variable even across different altitudes of a single state in NE India. There is more spatial variability if one moves to other areas of NE India such as Nagaland, where upland rice is ubiquitous and different types of leafy vegetables appear to be more important, with RTCs having a less prominent role (Jamir 2015).

Moving from the Himalayan foothills to the Asia-Pacific fringe, the literature indicates that the same basic characteristics of shifting cultivation apply (Yen 1974; Prain and Hermann 2001), though there is still considerable variation. In Papua and West Papua, part of the island of New Guinea and the easternmost provinces of Indonesia, the dominant crop in the high elevation swiddens is sweetpotato, with very little upland rice but an important presence of taro, sometimes yams (*Dioscorea spp.*), but little cassava. New Guinea is probably an additional center of domestication and diversity of taro and the crop was of overwhelming importance there, together with *Dioscorea spp.*, up to the 16th century (Yen 1991; Boomgaard 2003). The large-scale replacement of taro by sweetpotato among indigenous cultivators was related, according to a German naturalist who surveyed eastern Indonesia in the 1670s, to its agronomic and culinary characteristics, notably higher yields, easier management than taro, a superior ratio of production to labor input and the tastiness of the different varieties (Boomgaard 2003: p593). Recent research in both eastern provinces confirm the continuing key role of sweetpotato in multiple dimensions of Papuan livelihoods. Most of the large numbers of varieties planted in their swiddens are spreading types, which provide dense ground cover to reduce erosion on hillside plots that can have slopes in excess of 40°. Planting in January, immediately after the swidden has been cleared, and selection of varieties with early bulking provide earlier food (Prain and Hermann 2001; Mawikere et al. 2015). In central Papua province, the flat, marshy bottom of the Baliem Valley provides a different challenge for the Dani ethnic minority to open swiddens there. A special technique of raised beds is used for the sweetpotato, to overcome water-logging, whereas the taro can grow on the wetter sides of these beds (Yen 1974; Prain and Hermann 2001).

In lower-lying areas of West Papua and in other parts of Eastern Indonesia, cassava began to be introduced into swidden agriculture in the late 19th and especially the 20th century (Boomgaard 2003; Ellen and Sosisila 2012). These authors describe the introduction of cassava later on in the swidden cycle when soils are starting to be depleted and other crops fail to produce. They focus on the important contribution of cassava to risk reduction and underline the especially important role of bitter varieties which, even though their high levels of toxic cyanogenic glycosides require proper processing to make them edible, can be harvested up to three years after planting without lignating. Cassava displaced sago (*Metroxylon sagu* Rottboell) in many islands of eastern

Indonesia as the main starchy staple, producing food from poorer soils and being recognized for its ability “to stave off hunger” (Ellen and Soselisa 2012: p29).

Blench (2013), drawing on archeological, anthropological and linguistic sources, argues that RTCs are a key component of what he calls a “zone of vegeculture” which stretched from Nepal to Melanesia and preceded cereal culture in that region. In most parts of the region rice replaced the components of the vegeculture, but clearly it has persisted in contexts which favor the contribution of these crops to the resilience of this complex AFS.

4.1.2 Transformations of shifting agriculture towards permanent field agriculture

Shifting agriculture is an ancient system, but the literature also describes how it has been changing through adjustment to new economic, demographic and ecological realities (Fox et al. 2009; Cramb et al. 2009). The shortening of the fallow period due to increased pressure on land from a growing population, government forest conservation policies that have reduced access, as well as other factors have threatened the sustainability of the swidden systems. This trend has intensified in recent years, including in NE India and the contiguous hill area of Southeast Bangladesh. In these locations, fallow periods were reduced to as little as two years (Patel et al. 2015; Khisa and Mohiuddin 2015). The shortening of the cycle has been a main reason for the negative perceptions and attitudes surrounding swidden agriculture, even if governments themselves have exacerbated the situation by expanding forest reserve areas and sometimes assigning areas of shifting agriculture systems to plantation agroforestry, as reported in a study in Nagaland, NE India (Jamir 2015). Yet the same study also illustrates an opposite trend in length of fallow which is highly relevant to the situation of RTCs. In Nagaland, after shrinking of fallow periods during the 1970s and 1980s, there has been a more recent expansion in fallows as the size of plots has declined owing to reduced labor and increased intensification, with an increase in cash crop vegetables in this case, mostly at the expense of rice.

The trend towards increasing the cultivation of cash crops in swiddens, which has been driven by the growing involvement of indigenous communities in the cash economy, and the shift in many cases towards conversion of swiddens into permanent or dry field agriculture, has led farmers in many hill locations to pay increasing attention to potato. This has happened in NE India, the Philippines and Eastern Indonesia, among other locations (Ramakrishnan 1992; Prain and Hermann 2001; Dressler and Pulhin 2010; Jamir 2015). In NE India, Ramakrishnan and Jamir both describe the increasing introduction of potato and other vegetables in Nagaland as a swidden cash crop, and they identify its key role in the transition to permanent field agriculture. In Meghalaya, the major potato growing area is located in the East Khasi Hills, an area of former shifting agriculture that is now covered in permanent fields (Anantharaman et al. 2016). The same pattern has occurred in the Philippines (Dressler and Pulhin 2010). In the Arfak mountain area of West Papua, Indonesia, potato was planted on a small scale as a second planting after the original swidden had been cultivated for just over a year. Pigs were allowed into the swidden to ‘plough’ the ground, manure it, eat any remaining roots, and then potatoes were planted. This was done on a small scale before any road transport existed to connect the Arfak mountain areas to coastal markets, with potatoes marketed via small missionary airplanes that occasionally served the area. With the construction of a rough road connection, there has been a major increase in potato planting and marketing (Sawor et al. 1993; Prain and Hermann 2001; Wheatley 2015).

In eastern Indonesia, as described by Ellen and Soselisa (2012), cassava has also been a major driver of transformations of swidden agriculture towards permanent fields and monocropping in hillside farming in Asia. Ironside (2015) describes several processes through which cash-cropping of cassava within the swidden

gradually resulted in mono-cropping. In response to commercial opportunities and because of its resilience under low fertility conditions, it began to be planted directly into recently fallowed plots. Ironside (2015), Ramakrishnan (1992) and others describe it as one of the crops that contributed to the transformation from shifting plots in swidden agriculture to shifting crops in permanent field agriculture. Onwueme (2002) describes wide variation in cassava cultivation in Asia as a permanent field crop. In commercial systems, especially in Thailand, Malaysia and the island of Sumatra in Indonesia, it is monocropped. In mixed subsistence-commercial planting it is intercropped with groundnut, rice, maize or vegetables. In some cases, cassava helps to increase the overall productivity of plantation agriculture as it is planted under rubber or coconut trees, especially in South India, Philippines, Thailand, Java in Indonesia and in Malaysia. Although cassava enables farming families to bring low fertility soils into cultivation, Onwueme and others note that planting cassava on hillsides or in undulating topography and with often light, sandy-loam soils, can cause significant soil erosion. Various ways have been elaborated to overcome this constraint (Watananonta et al. 2007).

4.2. RTCs as rotation, relay and supplementary crops in lowland flood plains and coastal areas

The second major AFS involving RTCs in Asia is present in lowland flood plains and coastal areas, with RTCs as rotation or relay crops and often as semi-invisible 'secondary crops' (Campilan 2009) on the geographic and cultural margins of rice-based societies, but often with primary, food and resilience related functions (Castillo 1995). The widespread reputation of sweetpotato and also cassava and taro, as emergency crops or a poor person's food in these lowland environments in Asia derives from their marginal status. When disaster strikes the rice crop, sweetpotato especially becomes the emergency food. When poverty results in lack of access to rice paddies, RTCs are often the poor person's main crop option. This lies behind the Chinese saying: "when you have rice to eat, don't forget sweetpotatoes" (cited in Wolf 1992). The secondary status of RTCs in these systems partially explains the limited literature describing their cultivation and use, and the unreliability of the production statistics quantifying their presence. The unreliability of agricultural statistics in general was raised by the economic anthropologist Polly Hill in the 1980s (Hill 1984), and it was further discussed in relation to RTCs by Scott et al (2000). The political influence on these statistics was recently highlighted for two African countries and India (Jerven 2014). The first phase of FoodSTART was sensitive to this problem and undertook a pilot study in the Philippines to ground-truth official statistics to understand the extent of errors in official agricultural statistics and the way that different agencies report different information (Gonzalez 2013; FoodSTART 2015).

In Asia, sweetpotatoes and cassava are relatively common crops in upland fields in river basins and on the flood plain, sometimes between rice crops and often in areas not suitable for rice (Even et al. 2016; Wilkins 2017). Literature on conservation agriculture and agro-ecosystem management in Asia indicates that sweetpotato alone or intercropped can help suppress weeds (Singh et al. 2015; Shen et al. 2015). Both sweetpotato and cassava have been identified as cover crops which contribute to reduction of erosion in these low-altitude coastal and river basins areas as well as in hill areas (Campilan 1995; Srinivas 2009; Wilkins 2017). The cultivation and use of sweetpotato in post-rice systems in Southeast Asia was discussed by Campilan (2009)⁷. He identified Indonesia, Vietnam and the Philippines as the main producer countries; in 2017 these countries accounted for 94% of sweetpotato production in Southeast Asia, according to the FAO official statistics (FAOSTAT 2018). The crop is most frequently grown as a rainfed crop after rice in Indonesia, taking

⁷ This does not include East Asia, especially China. China is the largest producer by far of sweetpotato in the world and a huge proportion of the production is cultivated post-rice in southern China. For a detailed discussion of the different systems of production of sweetpotato in China, see Vander Zaag (1991) and Zhang et al. (2009).

advantage of residual fertility and moisture in the soil and in some areas, such as the island of Java, with additional organic or synthetic fertilizer added. This is justified in Java by the frequent sale of the crop for fresh and processed use (Wheatley 2013). Cultivation of sweetpotato post-rice and in mixed plantings with other annual crops is especially important in the drier islands of East and West Nusa Tenggara.

In Vietnam, sweetpotato is also planted post-rice and in marginal, poorer soils, especially as a food security crop and as a source of pigfeed. In the Red River Delta in the north, the widespread planting after rice and sometimes relay-cropping into maturing rice fields is especially important for pigfeed. Some plots of sweetpotato at certain times of year are only planted for piecemeal cutting of foliage as forage. The historical and continuing role of sweetpotato in rice-based systems as a source of pigfeed is hugely important throughout non-Muslim and non-Hindu areas of Southeast and East Asia. Here pork is the preferred meat and there is a continuing increase in demand. A recent estimate suggests that between 20-30% of Chinese sweetpotato root production is used in this way, or around 25 million tons (Zhang et al. 2009). Almost all sweetpotato vines are destined for forage.

In south Vietnam, especially in the Mekong delta, sweetpotato is planted more commercially, including for the production and export of purple varieties (Wheatley 2013). Planting of sweetpotato post-rice in the central coastal region of Vietnam has a key role as a buffer crop (Hoa et al. 2000) in case of the failure of the rice harvest. Typhoons are a major cause for such a failure in this region, forming in the northern Pacific after summer increases in surface sea temperatures. As well as documentation of their effect on the central coastal Vietnam, the literature discusses the severe effects on livelihoods and food security of typhoons and tropical storms hitting the eastern coast of the Philippines, southeastern China and, as cyclones forming in the Bay of Bengal, affecting eastern and north-eastern India and Bangladesh (Attaluri et al. 2010; Huq et al. 2015; Evan et al. 2016; Roa et al. 2016). It has been found that while rice and other crops such as coconut trees in east-central parts of the Philippines are very vulnerable to typhoon winds and storm surges, spreading varieties of sweetpotato and other RTCs are much less vulnerable. Sweetpotato will also continue to have a special importance in these typhoon-affected areas as a feed crop in preference to maize, which is susceptible to strong winds (Vander Zaag 1991).

In the massive sub-tropical Indo-Gangetic flood plain of northern India, eastern Pakistan, southern Nepal and most of Bangladesh, as many as 600 million people are dependent on the cereal-based cropping systems that cover more than 100 million hectares of that region (Gupta et al. 2003; Jat et al. 2006). There is a growing literature on ways to increase the economic and nutritional sustainability of the region through horticultural diversification. Potato is one of the important post-rice crops, grown during the cooler winter season (Bardhan Roy et al. 1999; Jat et al. 2006). The development of shorter-maturing potato varieties with different types of abiotic tolerances offers the chance for potato to expand further in this vast cropping system and to provide farming households increased income, nutritional benefits and resilience in the face of increasing heat, drought and salinity stresses.

4.3. Homestead or backyard gardens

The final major AFS cited in the literature to which RTCs contribute resilience in different parts of Asia is the home or homestead or backyard garden in both rural and urban areas (Mula and Gayao 1991; Ramakrishnan 1992; Boncodin and Gayao 1998; Boncodin et al. 2000; Jamir 2015). Ramakrishnan (1992) and Jamir (2015), whose major focus is the swidden systems in NE India, note the role of homegardens for household nutrition and health via the cultivation of medicinal plants and the way they occupy the available space around the

homestead and in marginal spaces like the sides of dykes further afield for the production of complementary and buffer food. Tree crops and climbing crops, like chayote (also known as mirliton squash) and different kinds of gourds, are also key components of homegardens which exploit vertical space (Wiersum 2006). As many of these writers make clear, RTCs are regular components of homegardens throughout the Asia region, with the exception of potato, which is not commonly planted. These authors show that RTCs from homestead gardens make an important contribution to supplementary household food supply managed by women, and have contributed emergency food in post-disaster situations (Sano et al. 1991). In situations where women experience restrictions on physical mobility, such as in Bangladesh, homestead gardens are a way for women to contribute food to the family, provide a buffer in times of stress or shock and to offer a small source of income for women (GENNOVATE RTB-HT team 2017).

5. RTC traits contributing to agri-food system resilience under climate change

There is a large technical literature on RTCs, including on their genetic diversity, breeding activities, agronomic traits, responses to biotic and abiotic stresses, and post-harvest and human nutrition aspects. As the Google Scholar searches revealed (see Section 2), research attention is variable for the different crops, reflecting their different economic significance. For all RTCs there has been limited research specifically on their adaptive potential in response to climate change (Morton 2007), though this is beginning to change, especially in relation to varietal resistance and tolerance, particularly for potato, sweetpotato and cassava, so far with more emphasis on Africa (Kroschel et al. 2015; Atlin et al. 2017; Dinesh et al. 2017;). But as Atlin et al. (2017) point out, “the genetic architecture [for stress tolerance] tends to be highly polygenic” and even where large-effect alleles for stress tolerance do exist, they “must be packaged in varieties that are profitable to produce and demanded by end-users” and have an agronomic fit with their cropping systems (ibid: pp31-32). The following sub-sections examines key agronomic traits of RTCs as they contribute to different AFSs in Asia, especially shifting agriculture in hill areas and as a secondary food and cash crop in the lowlands. It also highlights efforts to introduce greater levels of abiotic tolerance through breeding.

Sweetpotato. Sweetpotato is an efficient crop producing higher quantities of energy per day per unit area than cereals (Srinivas 2009). It is also a robust crop requiring few inputs. The diversity of its genetic base and propensity for hybridization provide room for a wide adaptation, enabling it to thrive in a range of diverse marginal environments including irrigation bunds, riverbanks, field perimeters and homestead gardens from sea-level to over 2000 m a.s.l. (Gichuki et al. 2003). It can thus raise the overall productivity of different agricultural systems and landscapes in a sustainable way (Yen 1974; Rasco and Amante 2000). Sweetpotato is a vine and depending on variety can be short and compact or highly spreading, growing horizontally rather than vertically. Compactness favors relay or intercropping to increase the productivity of intensively farmed systems and is commonly deployed in this way in lowland systems in Vietnam, Philippines and China (Prain 1995). Spreading types are adapted to hillside field and shifting cultivation where they provide ground cover, suppressing weeds and reducing erosion (Loebenstein and Thottappilly 2009). The crop is typically grown under rainfed conditions and storage root development can be affected by water stress. But the crop has quite good drought tolerance thanks to both its physiology and its genetic diversity (Daryanto et al. 2016).

Sweetpotato is a perennial crop. Especially in shifting systems it can be maintained for several years, producing storage roots along the length of the vine when moisture is available, and escaping drought through its deep rooting system and extensive vine network in dry spells (Bourke 1985; Daryanto et al. 2016). There is also considerable evidence of drought tolerant varieties in the existing gene pool (Haimeirong 2003; van Heerden and Laurie 2008; Yooyongwech et al. 2014) as well as successful efforts to enhance drought tolerance through breeding (Gruneberg et al. 2015). Sweetpotato multiplication is usually via planting of vine cuttings, but in temperate climates such as central and northern China, roots are planted in seedbeds and the shoots or slips that grow from the roots are harvested and used as the main planting material in the field (Loebenstein and Thottappilly 2009).

Domestication of sweetpotato first occurred in the tropical Americas around 8000 BCE (Zang et al. 2000; Gruneberg et al. 2015) and archeological evidence indicates its early use along the salinity-prone coastal strip in what is now Peru (Ugent and Peterson 1988). The salt-prone coastal areas of Peru are presently the major production areas of the country and there is indication of salt tolerance in the sweetpotato germplasm

(Dasgupta et al. 2008; Gruneberg et al. 2015). Researchers in Bangladesh and in Vietnam are currently engaged in germplasm evaluation and introduction of this trait in Bangladesh (Rahaman et al. 2015; Kien et al. 2013).

The combined physiological and genetic makeup of the crop offers good adaptation and 'climate proofing', both to increasing abiotic stresses and to extreme weather events, better than most staple crops. In the aftermath of recent cyclones and typhoons that decimated eastern India and the central Philippines, sweetpotato was one of the few crops able to continue supplying food to the local population (Roa et al. 2016; Attalurai et al. 2010). The perennial character of the crop also contributes to more stable food security. Roots can be piecemeal harvested for up to five years in shifting systems (Prain et al. 2000). Furthermore, roots can be harvested after just 90-110 days after planting providing early availability of food and opportunity for marketing, and therefore potential benefits in overcoming crises (Loebenstein and Thottappilly 2009). Moreover, consumption of young shoots/vines is common in several Asian countries and represents an even faster source of nutrient-rich food than the roots after a disaster. Sweetpotato is also an important source of micro-nutrients, especially vitamin A, particularly in orange-fleshed varieties (Low et al. 2017). The combination of moderately high dry matter content and low costs of production makes sweetpotato an attractive raw material for processing in limited contexts. It has been a major source of bulk starch for food and other products in southern and eastern China since the 1980s (Fuglie et al. 2004) and a raw material for special food and beverage products in Japan, South Korea and Taiwan (Duell 1991).

Cassava. The robustness of cassava, especially its ability to grow in quite poor soils with low or no inputs and minimal husbandry practices, and its ability to produce deep rooting systems (more than 2 m) to extract sub-soil water are important characteristics for its inclusion within smallholder hillside AFSs and cultivation in areas where few other crops would survive (Howeler 2006; Ceballos et al. 2011; Jennings and Hershey 2013; Daryanto et al. 2016). Like sweetpotato, it has a broad adaptation from humid to semi-arid environments and from sea level to about 1800 m a.s.l. (Daryanto et al. 2016). Also, like sweetpotato, it is a perennial crop usually grown as an annual, but it can escape drought by going dormant, losing its leaves, and then reinitiating growth when there is fresh rainfall, even a year later (Ceballos et al. 2011). The crop has no fixed period of maturity, but needs from 7 – 18 months to produce commercial roots depending on varieties and conditions, especially altitude (roots take longer to bulk at higher elevations) and latitude (slower bulking in sub-tropical locations). Cassava can be piecemeal harvested earlier than 7 months for subsistence purposes. Cassava leaves are also an important vegetable in some areas of Asia, such as in Indonesia. Low costs of production of cassava combined with high dry matter has made cassava an increasingly important source of raw material for starch and derivatives, and for dried chips for use as animal feed. Thailand is the largest producer (and exporter) of cassava starch and dried chips, followed by Indonesia, Vietnam, China and India (Howeler 2006). Cassava improvement in Asia through breeding has mainly focused on high yield, with one program aimed at addressing a specific strain of mosaic disease found in India (Jennings and Iglesias 2002).

Potato. This is the third most important global food crop after rice and wheat (FAOSTAT 2018). Potato has high nutrient productivity, yielding under rainfed conditions more food per unit of water than other major crops such as maize, wheat and rice (Monneveux et al. 2013) and, as an FAO publication to mark the international year of the potato observed, it is a hidden treasure that is increasingly recognized and valued (FAO 2009). It is also one of the most productive food crops per unit of time, with some varieties maturing in just 90 days (Horton 1987). Nevertheless, potato is more susceptible to several abiotic stresses than either cassava or sweetpotato, especially to heat. According to different authors, potato has an optimal temperature range of between 15 - 20°C with higher temperatures having an increasingly deleterious effect on tuberization as well

as on the quality of tubers (Levy and Veilleux 2007; Daryanto 2016). It is therefore a sub-tropical winter or tropical highland crop in Asia. Potato is also more susceptible to drought stress than other roots and tubers, although the recent review of literature on RTCs and drought by Daryanto et al. (2016) suggests that potato is more tolerant to drought stress than previously thought (ibid: p125). However, as an annual crop with a shallow root system, it cannot survive prolonged lack of water. Breeding for drought and heat tolerance has therefore been of growing importance in the face of climate change and modeling these new varietal technologies to 2050 indicates that potential yield gains are significant (Islam et al. 2016). Breeding for drought tolerance is less advanced than in the cereals (Monneveux et al. 2013), but there are already varieties released in Asia with drought and heat tolerance (Gatto et al. 2018).

Soil salinity is another type of abiotic stress increasingly affecting coastal agricultural zones where potatoes are often grown, areas that are susceptible to rising sea levels and storm surges. Although a worldwide problem, soil salinity is severely affecting several Asian countries with Bangladesh facing a major challenge. Over half of coastal agricultural areas (30% of total cultivable area of the country) are affected by varying degrees of soil salinity (Munira et al. 2015). Potato is relatively sensitive to salinity, particularly in the early growth stages, and breeding for tolerance to salinity is therefore a key component of adaptation to climate change as a means of reducing risk affecting this often high-input crop (Rashid et al. 2008; Mahmud et al. 2016).

Taros and yams. As mentioned in Section 2, there is less research conducted on these RTCs, reflecting their lower overall economic significance. This is not to say that they do not make important contributions to AFS resilience in specific cases, as will be seen in the following sections. The most important species in Asia of these widely distributed food crops, namely *Colocasia esculenta* among the taros and *Dioscorea alata* and *Dioscorea esculenta* among the yams, have different types of tolerances that are important for AFSs. All three are adapted to high ambient temperatures, especially the *Dioscorea* species, which have an optimum growing temperature of 30°C (Lebot 2009). *Colocasia* is the only RTC that is adapted to waterlogging, so can often be found on riverbanks. The *Dioscorea* species are climbing vines and can occupy the remaining dead tree stumps of slashed and burnt swidden fields (Conklin 1975).

6. Perspectives of farming communities on AFS resilience and the role of RTCs: case studies from India and Philippines

In order to gain some sense of how members of farming households view the impacts of shocks and stresses on their agri-food systems, how they have prepared for and responded to these crises, and the role played by RTCs in these strategies, two short case studies were conducted. These took place in the two key macro-environments of concern to FoodSTART+ and which have been examined through the literature in Section 4: hill areas featuring permanent fields, swidden agriculture and homegardens; and coastal areas with livelihoods based on combinations of plantations and permanent field crops including cereals and relay or intercropping, homegardens and fishing. Through a small number of single-sex FGDs in the two environments (see Annex 2 for details of the methods and implementation), and drawing on the AFS resilience conceptual framework discussed in Section 3 to construct the guide questions for the FGDs, the small studies seek to ground truth the academic literature and illuminate further ways to analyze and strengthen AFS resilience.

Part of the methodology involved building a subjective picture of the socio-economic strata in the community, in order to facilitate a discussion about differences in impacts and responses among different strata. The tool used for this is called ladder of life (Petesch et al. 2018a; Petesch 2018b). The details of the tool are described in Annex 2, but for the purposes of understanding the rest of the section, there are references to the different steps of the ladder of life. The top step describes those best off in the community, with subjectively generated indicators of what this means, and the bottom step refers to those who are worst off in the community, with a corresponding set of indicators.

In the following sub-sections, the two environments where the case studies were carried out are described, then the shocks and stresses identified by the men and women FGDs and their immediate impacts discussed. The next sub-section describes the preparedness of households and the communities for the shocks and stressors, and then the different kinds of responses taken by individuals, households and communities presented, taking into consideration the 3-D response capacities framework of coping, adaptation and transformation (Bene et al. 2012). This discussion also considers the differential capacities of different socio-economic strata in the community for preparation and response. The following sub-section considers interpersonal and institutional dynamics within households, communities and, in relation to external organizations through assessment of decision-making processes within households, the extent to which social capital was an important component of response and also the role played by external agencies in supporting the response and recovery. A short sub-section considers evidence of subjective resilience from these studies. The final sub-section pulls together the perspectives of participants on the role of RTCs in their capacity to respond to and recover from shocks and stresses.

6.1. The two environments

Northeast India has already been introduced through the literature review in Section 4. Lying in the foothills of the Himalayas, it is an undulating low to high altitude, forested terrain with temperature and rainfall in the hillier parts very different from lowland North India. The abundant forest environment has shaped the system of swidden agriculture (known as *jhum* in that region), practiced for hundreds of years by the large indigenous population made up of more than 100 ethnic minority groups (Ramakrishnan 1992). Population growth and encroachments by governments and the private sector, among other factors, have led to a reduction in the

forested area and changes in the agricultural systems, especially the growth of permanent field and plantation agriculture alongside the jhum.

It is important to take into consideration the socio-cultural context of this region. In the hill areas most families are Christian, and there is a long-established matrilineal kinship system with matrilocal settlement, meaning that the groom moves to the wife's village and often to the wife's family's household (Lyngdoh 2014; but see also Nongbri 2000). This means that the position of women is quite different than in most parts of Hindu or Muslim India. The State of Meghalaya, where the first case study was located, has very high rainfall: –it boasts the highest rainfall in the world in the town of Cherrapunji on the southern escarpments of the state above the plains of Bangladesh, with an annual rainfall of over 11000mm. That is exceptional; the average rainfall further north in the East Khasi hills, where the first set of FGDs was conducted, is around 3600 mm. To the west, in the West Garo hills area, where the second set of FGDs was held for this case study, it is around 3,100 mm. The main rainfall is distributed during May to September but can also fall at other times. Despite the distance from the Bay of Bengal, Meghalaya is also exposed to cyclones from time to time. The hill areas have a much cooler climate throughout the year compared to the lowlands, with an average maximum temperature in Shillong, the capital of Meghalaya, of 17°C in winter (November to February) and of 23°C in the rest of the year. This allows the cultivation of crops such as potato pretty much throughout the year.

The second case study was located in east-central Philippines (Region 8 in the Philippines administrative system). Region 8 is the eastern-most region of the country and consists of three large islands, Leyte, Samar and Biliran, bordering the Pacific Ocean. The islands consist of flat, fertile coastal zones and hill areas in the interior of the islands. The climate is humid tropical and local people describe the rainfall pattern as bimodal - a rainy season and a rainier season. Precipitation is highly variable year on year, for instance ranging from 2700 mm in 2011 to 5200 mm in 2012 (Samar 2019). The region has already been mentioned in Section 4 in the context of the dominance of coastal coconut plantations in the agricultural economy and the planting of RTCs as secondary crops. The coastal population is heavily involved in small-scale capture fisheries using small boats and nets. Most households combine fishing with farming to provide food and income when the heavy winds that blow in from the Pacific during months from August to February make fishing difficult and dangerous. The region is very exposed to the typhoons that frequently form in the central Pacific during these months and which can bring destructive winds, flooding, landslides and storm surges. In terms of the socio-cultural context, an important element is the relatively empowered status of women, with a strong focus on girls' education and strong engagement in social networks and in different types of employment (Godquin and Quisumbing 2008). The two sites chosen in east-central Philippines for this case study were both on the island of Samar in the Eastern Visayas region: a fishing municipality called Guiuan in the south-east extremity of the island with maximum exposure to the Pacific, and another one in Marabut municipality, located on the western-facing coast of the island, in San Pablo Bay.

6.2. Shocks and stresses across the two environments and their general and RTC-related impacts

The first part of the discussion in the eight single-sex FGDs in the four chosen locations focused on the shocks and stresses that had affected them in the past 10 years and which had been most severe and disruptive

Table 1. Most important shocks and stresses impacting the localities of selected case studies over the past 10 years

	Meghalaya, North-east India				East-central Philippines			
	Khasi women	Khasi men	Garó women	Garó men	Guiun women	Guiun men	Marabut women	Marabut men
Main shocks	Price collapse for agr. products (2017)		Cyclones (2010, 2018)	Flood (2014)	Typhoon (Yolanda 2013)	Typhoon (Yolanda 2013)	Typhoon (Yolanda 2013)	Typhoon (Yolanda 2013)
		Cyclones (years not specified)	Flood (2014)	Cyclone (2004)			Drought (El Niño events (2010, 2015))	Extreme and sudden changes from hot weather to rains (climate change)
			Hailstorm 2005	Hailstorm (2018)			Typhoon (Ruby 2014)	Landslide 2016
Main stresses	Pest attacks from 2014	Livestock mortality (multiple years)			Economic crisis with price hikes (several years, 2018 bad)	Coconut disease (2011-2012)	Pest infections	Banana pests
	Potato bacterial wilt from 2016	Drought (multiple years)			Banana disease	Banana disease (2014 – present)	Reduced fish capture (dynamite fishing etc)	Coconut pests
Other important events not prioritized	Cyclone (2017) Reduced rainfall		Reference to interruption of bamboo flowering, affected by shocks – serious implications for a vital building material	No social unrest or price shocks reported. N° observations about pests and disease	Other typhoons, earthquake (2013), some pest infections of cassava, bitter gourd, coconut Drought Restrictions on collection of shells for handicrafts	Other typhoons, earthquake (2013), some other pest infections	Other typhoons, earthquake (2013) Pest infections linked to CC, Pollution from location of livestock near rivers	Other typhoons, earthquake (2013)

In the hill areas of NE India, there was a great diversity of shocks and stresses mentioned, partly due to the significant difference in the micro-climates of the two locations in East Khasi and West Garo (Table 1). Khasi women identified a price collapse for agricultural commodities in 2017 as a main shock, and the presence of pests and diseases – especially bacterial wilt of potatoes – as stresses. The increased presence of bacterial wilt may be linked to a climate change-related increase of both winter and post-monsoon temperatures in the state (Chaturvedi et al. 2017). Khasi men recalled the devastation of the cyclone which happened earlier than the 10-year period, but still left a mark. They identified high livestock mortality as a serious stress occurring in multiple years, and also increasing incidence of drought. Their reference to the high mortality of animals may have been linked to the drought.

For the Khasi women in eastern Meghalaya, the price collapse for agricultural commodities in 2017 hit potato badly. “Throw away prices” one woman commented. They also emphasized the seriousness of income losses resulting from pests and diseases, especially affecting new potato varieties, other vegetables and also rice. These income reductions had a severe effect on their capacity to ensure sufficient food for the family. These pests and diseases did not affect sweetpotato or what they described as a “local potato variety” (*Lah Tung*), so these were still available to eat.

Khasi men also identified reduced income from the potato crop as the main impact of drought stress, but also said that production declined in other crops and affected livestock and also humans. The men’s memory of the impacts of the cyclone was mainly about the destruction of staple food crops, rice and maize, and the resulting food shortages. They also emphasized the longer-term impacts of the cyclone in the destruction of seed stock that would be needed for planting in the following season.

In the western part of Meghalaya, both Garo men and women identified the localized crisis caused by flooding in 2014, as well as the effects of the cyclones that hit the state in 2004, 2010 and 2018. In this high-altitude environment, both men and women commented on the destruction caused by hailstorms.

Both Garo women and men graphically described the impact of the flooding in 2014. Livestock were “washed away”, “almost totally lost” and paddy fields and vegetables were destroyed, shops submerged so that families could not buy much needed food and there was a lack of food and money in their household. Effects of flooding on their commercial plantation tree crops, namely cashew, areca nut and black pepper (a vine that climbs the trees) seemed contradictory. Some said they were affected and other that they were least affected. It seems that some of these trees were uprooted by landslides provoked by the flooding; those who commented on the effects on the tree crops were referring to these secondary effects of the flooding. The trees not impacted by landslides were not seriously damaged, since they were above the level of flood waters. Nevertheless, the women said that because of the flood waters these crops could not be harvested, restricting further their access to income. Root crops like sweetpotato, cassava and taro planted “in the lowland areas” – this refers to both homegardens and low altitude permanent fields – were destroyed.

The men’s group estimated that on average two thirds of family’s holdings were destroyed, with paddy fields covered with stones and sand. Homesteads were also damaged or destroyed, including “houses, beds, books and utensils...” However, the jhum crops on the hillside – especially sweetpotato, turmeric, yam, cassava and ginger – were not affected and were an important source of food during these difficult times.

In the case of both cyclones and hailstorms, the commercial plantation crops of cashew nuts, areca nut and black pepper were badly affected, as were the houses which were severely damaged. In both of these shocks, “small plants like sweetpotato and potato were not damaged”.

In Samar, Philippines, the massive destruction of the Super-Typhoon Yolanda (international name Haiyan) which struck the central Philippines in 2013 is uniformly reported as the biggest shock for all four groups. Typhoons occur most years, so there were also other typhoon shocks mentioned by these groups, but none as serious as Yolanda. Apart from the Yolanda shock, men were uniformly concerned with pest and disease stresses affecting their main plantation crops, coconut and banana. The problem of unstable weather patterns which was identified by Marabut men and attributed to climate change affected vegetable production, with drying out of these crops, followed by heavy rain which caused damage and water-logging. Women were also concerned with pest and disease stresses that have economic implications on their main crops but also report suffering the stress of unstable prices during the 10-year period. Marabut women also reported serious problems from the shock of the 2010 El Niño, with drought affecting crops and a warming sea surface causing reduction of fish catches. They also commented on the increasing use of unsustainable fishing practices that reduce fish available for sale.

On the eastern coast of central Philippines, images of the impacts of Super-Typhoon Yolanda were broadcast around the world in 2013. The women in Guiuan, which was directly hit by the typhoon, talked of their destroyed houses, their loss of belongings and food stocks. Men commented: “All were affected, all crops were affected by the typhoon. Even the grasses were blown away...even rocks and stones were moved and blown by the wind; how much more our sweetpotatoes (were blown away).” The women commented about the increases in diseases such as diarrhea because of the contamination of drinking water with sea water. They had to obtain mineral water or boil their water. There was major inflation of prices after the typhoon: the price of a box of matches increased by 500%. Because of the debris in their plots that had to be cleared, it was a month before they could start planting again. There were food shortages. The main shops were five kilometers away but there was little transport and the owners of what was available had made major increases in charges to compensate for higher fuel costs.

In Guiuan during the typhoon, the most affected livelihoods activities were fishing and coconut plantations, with banana plants also badly damaged. Men and women reported that sweetpotato and cassava were least affected by the typhoon and provided food. Another RTC, *palauan*, or giant swamp taro (*Cyrtosperma merkusii* (Hassk.) Schott.) was little affected, according to the women, and as will be discussed in the next sub-section, collection of the corms of this plant was an important coping strategy for poor people after the typhoon. Yet the men’s group suggested that this crop was also badly damaged and its very large leaves could make it vulnerable under some circumstances. The women also mentioned the destruction of another source of livelihood, the *bariw* grass which they use for weaving mats.

The men of Guiuan also commented on the stresses they faced, mainly the banana and coconut pests and diseases. “The money that we are supposed to use (from sale of bananas) to buy the food we need is gone, because we cannot sell the infected bananas. Our income is greatly reduced. We depend on the crops. Our efforts are only wasted because of this disease”. The men in Marabut also commented on the slow decline of incomes due to coconut pests.

Both women and men in Marabut also reported similar devastation following the arrival of Yolanda. They describe the loss of houses, assets and livelihoods. They could not access drinking water or food. People got hungry. They described the uprooting of whole coconut trees, the main source of livelihood in the municipality. The women also mentioned the effect on the education of their children. The schools were taken over as evacuation centers and it took months for normal classes to resume.

Of the crops most affected, the tall stands of coconut and banana were immediately destroyed, but farmers also lost their vegetables in homegardens and fields, such as eggplant, tomato, bitter melon, bell pepper and others. The crops least affected by the typhoon were the RTCs, sweetpotato, cassava, yautia (*Xanthosoma spp.*) and taro.

Both men and women were asked if they noted any change in frequency of shocks or stresses. In both Guian and Marabut, women and men agreed that typhoons were more frequent than in the past. The men in both locations tried to see the lighter side of this disturbing observation. In Guian, the men commented that “recently the typhoons are becoming more frequent. All the letters of the alphabet are used up within the year⁸...”. In Marabut, the men commented that: “the strongest typhoon that we have encountered is Yolanda. But since then the typhoons (that come) are just like snacks for us...”.

6.3. Preparedness, responses and implications for RTCs depending on socio-economic status

The idea that it was possible to be prepared for the shocks and stresses that afflicted the communities in NE India over the past ten years was in many cases an alien idea. For the Khasi women facing the stress of repeated outbreaks of bacterial wilt or insect pests, they said they did not know how to prepare, although some women commented on their practice of removing infected plants and burying them to reduce spread. Men mentioned hilling up maize plants to provide greater resilience as cyclones began to develop. Women in Garo Hills felt there was no way to prepare for either cyclones or hailstorms, suggesting that unlike the relatively sophisticated evacuations and food stockpiling in coastal Odisha or in low-lying areas of Bangladesh facing the same cyclones, there was no early warning system available to the communities in the hill areas. For flooding, women said they monitored water levels in local rivers and streams. In answer to the question about whether the experience of a flood crisis in 2007 had not led them to prepare better for the 2014 flood, the Garo men replied that the 2007 event was caused by a breached dam, so they assumed it was a one-off event. In this case it seems they paid more attention to the cause than to the disastrous effects of flooding.

Among men and women in the two Samar communities in the Philippines who suffered the calamity of the Yolanda typhoon, there was some preparation, both official and through local initiative, but there were also misunderstandings and miscommunication which resulted in more suffering. Women in Marabut, which was where the typhoon first landed, and also in Guian, commented that they were so used to typhoons that they did not make special preparations. They heard about the ‘Super-Typhoon’, but did not know what it meant; they heard about storm surge but did not know what that meant either. They were told through the municipality to evacuate away from the shoreline, but without further explanation of next steps or for making other preparations. The men’s group in Marabut indicated that some of their spouses prepared food, flashlights, documents and other items in plastic bags. Some men in Guian tried to ‘shackle’ their roofs, but it proved to be ineffective. They brought their boats ashore and harvested all their crops that were almost mature. The rest were left in the ground. Some men described evacuation of their families to the local school. Despite the mandatory evacuation issued by the municipality, this was not strictly enforced and the Guian men’s group described how many men refused to leave their houses because of fear of theft. Others described whole families staying put: “We should stay in our home, altogether. Because whatever happens, we are in the comforts of home and together.” The Guian groups described the distribution of food rations by the municipality before the typhoon made landfall.

⁸ Naming of typhoons follows the letters of the alphabet.

Although there were comments that “all were affected, regardless of status” from the typhoon, there was also widespread agreement across all four groups that there were big differences in preparedness between those they had identified as on the top rung of the socio-economic ladder of the community and those on the bottom two steps. Some families from the top step were able to leave the area before the typhoon arrived, evacuating to the regional capital of Cebu or to Manila. Those who stayed were able to stockpile food, especially rice and canned goods. Perhaps the most important difference between those on the top step and those on the bottom step identified by women and men in both communities concerned information. Warnings, instructions, advice about food rations and other important information were communicated via radio and television. Poorer families did not have access to this possibly vital information.

In the conceptual framework for resilient agri-food systems, three types of response were identified: **coping**, **adaptation** and **transformation**. In the following synthesis of the FGD discussions about responses to the shocks and stresses that have affected their communities over recent years, these different types of responses will be examined.

For many Khasi women the immediate response to the loss of income suffered from diseases (of potato and other crops) and from price collapses was to change the diet of the family. The changes varied depending on the socio-economic step of the ladder the household occupied. For the middle steps, this included increased consumption of sweetpotato and lower-cost vegetables instead of higher-cost vegetables and meat. For families on the bottom step, it meant skipping meals. For many families, it meant selling livestock. They also mentioned ways to reduce the demand for food in the household and possibly access additional income, again, mostly among households on the bottom step. Adolescent girls were sent to work in the nearby town, especially as maids, and younger children were sent to better-off relatives “for being fed at least twice a day and looked after”. Khasi men mentioned changes in the way they deal with mostly informal loans with relatives in those situations. Either they negotiate a longer period of repayment, or they simply delay paying back. Beyond these coping mechanisms, Khasi women described several adaptations to the new situation, especially encouraging the men to seek work in other villages as migrant labor. In that sense, adolescent girls moving to local towns as maids is both a coping strategy – reduce food intake in the house – and an adaptive strategy to increase income of the household. When Khasi women were asked whether some people in their community just gave up or lost hope in the face of the shocks and stresses, they say they do not give up. They find ways to continue farming through buying or borrowing seed from neighbors.

According to the Garo women and men’s groups, they coped with the flood crisis through immediate evacuation to the hill areas. Some people also evacuated to the local town or took shelter in the hospital there. Those who stayed changed their diets but, unlike in the East Khasi Hills, did not reduce meals, according to the men’s group. This was avoided mainly through food donations from relatives, which will be discussed in the following section. According to women, Garo people did change the content of the diet, with jackfruit, banana, taro and sweetpotato the staples that replaced rice and pulses. The men also emphasized the shift in diet, especially consumption of sweetpotato and taro in the difficult times immediately after the shock. They say that these crops help in recovering as well as in coping under the difficult situation: “The people used to sell sweetpotato and tapioca (cassava) and they also used to make chips out of the tapioca.” In the recovery, they commented that “you can get food from sweetpotato and tapioca after three months, whereas replanted areca nut and cashew take a number of years.” Both in response to the flooding and to the destruction caused by the cyclone, women and men sought work as daily laborers with wealthier families in other villages, often for months, to recover. The main aim of this work was to earn and save money to purchase new animals and seeds for planting, although restarting cultivation went in parallel with the laboring, since families who lacked

immediate funds to purchase seeds would borrow seeds from friends and family. It seems that the marital linkages between the affected household and the family of the man living in another village was instrumental in this seed replenishment. Both Garo men and women's groups emphasized the way those households on the top step of the ladder are "quicker in recovering their loss" and that their savings were a major reason for the speed of their recovery, enabling them to buy back what they had lost. Garo women also commented that the disproportionate impact of the crisis on poor families was because of their poor housing and their lack of any savings. Therefore, their recovery was doubly difficult.

Recovery by the communities on the Philippine island of Samar was also variable depending on socio-economic status. For those on the lower steps of the socio-economic ladder, foraging fallen coconuts, bananas and other crops was their first resort, according to both Guiuan men and women's group. The women also emphasized that those on the bottom step consumed *palauan* (swamp taro) as well as bananas. The women also discussed another coping strategy by those on the lowest step: looting of food from fields and other locations, possibly from shops in the town center. Those on the top steps were able to cope easily because of their food stocks. The men commented that for those on the middle step, they just waited for relief food to arrive. But the women talked of a greater level of proaction, communal clearing of debris from the neighborhood, then repairing houses and finally, planting crops with newly purchased or borrowed seed.

In both Guiuan and Marabut women talk about the shift of diets because of the absence of rice, especially to banana, cassava and sweetpotato. But they also talked about recovering 'drenched' rice, which was spoiled by the rain. Though it smells bad, they cooked it when possible as part of their coping effort. Women commented that those on the top step were able to cope with the post-typhoon situation by moving out of the area. For households on lower steps, they stayed with relatives or put together makeshift houses from local debris. These people were also dependent on emergency rations. Planting of sweetpotato cuttings that had been salvaged was one of the first agricultural activities according to the women's group in Marabut. Others planted sweetpotato six months after the typhoon, surviving in the meantime on emergency rations.

Several adaptive and even transformative actions were described by both men's and women's groups in Marabut. In the men's group, a participant used to get income through collecting, fermenting and selling coconut wine (*tuba*). "After the calamity, all the coconuts were toppled down. Now, I mostly make and sell candies like coco bars" through using the fallen coconuts as raw material. The men's group also described several cases of fishermen whose motorboats had been destroyed, turning to farming: "After Yolanda, I had no choice but to farm crops (tomatoes and other vegetables). Today I own a paddle boat. Our house is far from the sea...in the foothills...we plant vegetables...I now engaged in farming as well as fishing. However, I am only able to fish near shore because I only use a paddle boat." Other farmers also took up vegetable farming and they formed a farmers' association (the women pointed out that to be eligible for NGO financial assistance, they had to form associations). Similar cases of diversification were mentioned by women. From only planting vegetables and RTCs in their backyard gardens, which were damaged in the typhoon, they are now also planting these in the hillside, "even behind the first hill" according to one of the women.

A transformative change was described by a member of the Marabut men's group:

"My wife went to Manila to look for work after Yolanda. Once the assistance from different government agencies and NGOs came in, I talked to my wife to come back and help me take care of our farm. The silver lining of Typhoon Yolanda is that it forced my children to work abroad. I was the one who told them to work there...We had no more coconuts and I was not (yet) working at the Local Government Unit at that time."

This household adapted in the short term through the wife's internal migration, but then transformed the basis of their livelihood through the sons' overseas migration and contribution of remittances and the father's entry into non-farm work. Accordingly, farming became a small part of the overall livelihood of the family.

Adaptation and transformation do not seem to be fully tied to being on the top step. The coconut tapper mentioned above would have been on the lowest or second lowest step. The family that transformed its livelihood does not seem to have the characteristics of the top step. Another participant of the Marabut men's group also commented on adaptation and transformation among those on the two bottom steps of the ladder that deserved government support. These people "worked hard and now have better status. They put up businesses which became successful." Dramatic change in circumstances through a kind of adaptation were also reported by the Marabut men's group: "There were cases where people from step 1 (bottom step) augmented to top step after Typhoon Yolanda because of the assistance they received." This group and also the Guiuan women's group indicated that some of these successes were the result of favorable treatment because the recipient was a member of the same political party as the local government. Similarly, they commented on those on low steps who failed to receive any assistance though they were in real need, because they were in the wrong political party.

6.4. The dynamics of household decision-making, social capital and external support in recovery

In Section 3.3, the literature addressing the relationship between resilience and food and nutrition security clearly emphasized the importance of understanding intra-household dynamics. A household coping strategy may benefit some members but harm others. The strategy of sending adolescent girls to work as maids in East Khasi Hills helps the household cope but can have negative long-term impacts on a 14-year-old girl who has to leave school and may become vulnerable to sexual abuse. This short study could not explore in detail intrahousehold dynamics, but through comparing results of same-sex FGDs on decision-making we hoped to get some insight at least into gendered decision-making.

In East Khasi Hills there was little documented either in the women or the men's FGDs on the issue of decision-making, but there was a difference in tone. The women are clear that they make decisions about selling livestock, which they mentioned as one of their coping strategies. The fungibility of this asset, which is often under women's responsibility, was discussed in the literature as illustrating the challenges women face in accessing assets and keeping them within the context of household resilience strategies (e.g. Kumar and Quisumbing 2014). Women also say that men decide whether they themselves will migrate or not. Women also indicate that if men do migrate for work, a high priority for the cash that they bring home is to buy new livestock. Men are more circumspect about decision-making in East Khasi. They say they consult their wives for all preparations for and responses to shocks and stresses. They mention especially the need to consult on the choice of old or new crops to replant after the crisis. This suggests that they defer to the adaptive capacity of the wife.

The decision-making dynamics within households of the Garo ethnic group seems different, but also sounds like the expression of prevailing norms. Women say that the head of the family (the father) makes decisions and that most times men lead and delegate. Men go to the forest to get bamboo and other materials for rebuilding the house. They seek help from neighbors. Men also mention that "since men are head of the family, they are the ones who take decision and the women also cooperate and the son-in-law also cooperate with the head of the family". The reference to the sons-in-law reflects the matrilineal system in Garo and are likely to be the sons of the wife's brother. The group also clarified that the man would assign tasks to his wife

and children for the farming, livestock keeping and household chores if he migrates for wage labor. This is a strong contrast to the Khasi situation, even though both are matrilineal societies where women have a strong position and can often be found as village leaders.

How much does social capital play a part in agri-food system resilience in the communities studied in NE India? Men and women in both the Khasi and Garo FGDs emphasized the readiness of relatives and neighbors to help others out, especially with food and rebuilding. When people ask for help, “they never come back empty-handed”. Those on the bottom step will get communal help to rebuild their houses, according to Garo women. But as Khasi women pointed out, usually the shock or stress affects all members of the village, so during those times social capital with relatives in other villages plays a crucial role in recovery. Garo men also mentioned the importance of help from siblings, who, in the matrilocal marriage system would most likely be living in other villages. Garo women and men also commented on the tendency for people to turn to those not affected by the shock, which probably means relatives in other villages, and that when they go to ask help, they bring back not only food and money, but also livestock. There is clearly also local support, especially work teams to help rebuild houses, but also some supply of food and clothing, firewood and utensils. Khasi men indicated that though there could be help with rebuilding and with food and basic necessities, the longer-term recovery process involving re-establishing agriculture is left to individual households. In Garo, the situation may be slightly different. The women’s FGD indicated that the headman could allocate a piece of his own land to those on the bottom step to cultivate for one year, as a type of community safety net.

Decision-making in the Philippines cases in Guiuan were quite clearly defined, especially by the women. The women took charge of securing food through decisions about crops to plant. They mentioned early planting of sweetpotato, by buying sprouted sweetpotato roots for 25 pesos (about USD0.50). Men also indicated a clear division of responsibilities between women attending to the safety of the family and men attending to the security and rebuilding of the home. Some men indicated that they followed the decision of the women in the family: “We evacuated as per decision of my wife, because our home will not withstand the typhoon.” In Marabut, which is about a two-hour drive from Guiuan, decision-making was quite different. The women’s group said that decisions-were mainly taken by men. For dealing with repair of the houses, they took the decisions and began the work, with women serving as laborers. For food, men looked for bananas, wild taro and sweetpotato to scavenge. Women cooked the food. The men’s group painted a very different picture. “Gender equality means we should give importance to women” was one of the first contributions. Another participant said that his wife had told him to invest in a motorboat for fishing before the typhoon, because there were many fish. He followed his wife’s advice. His boat was not damaged in the typhoon and now he follows his wife’s suggestions.

Social capital seems to be much less evident in Samar as part of the response to Super-Typhoon Yolanda than in the face of floods and economic shocks and stressors in NE India. In Guiuan, the men’s group commented: “after the typhoon, everyone returned to their respective homes. Every person in the community was busy attending to their own belongings and finding some food and water. So, we really didn’t get the chance to ask help from others. We can’t really rely on other people, that’s why we have to work hard for ourselves. The concept of *bayanihan* (communal unity, mutual support) was not present at that moment.” The women’s group in Guiuan gave a very similar answer, on the basis that all experienced the same disaster and crisis and had to be self-sufficient. The women indicated that people received support from relatives outside the disaster zone. In contrast to the situation in Guiuan, both men and women in Marabut talked about mutual support, “the cooperation of effort”. “Those people who have nothing, they give.” The men described the formation of associations. The women talked of the presence of bayanihan in the community post-Yolanda and the fact that

“no man is an island”. This contrasting perception of social capital in two communities only two hours apart is striking. Bayanihan is certainly an important part of Filipino culture, but a recent publication on the aftermath of Yolanda (Eadie and Su 2018) suggests that the more common situation was its absence rather than its presence. This was mainly due to the uneven and sometimes delayed distribution of aid and the competition and envy that generated, a situation that was hinted at in some of the responses in our own brief study.

If there is ambiguity in the results from this study about the level of social capital contributing to resilient responses to the shock of Typhoon Yolanda, there was no doubt about the level of external support, even if that support was uneven and sometimes prioritized based on unclear criteria. A long list of government and NGO agencies were mentioned by both women and men’s groups, offering everything from food rations, kitchen utensils to temporary housing, material for reconstruction of housing and boats, to cash for work and cash grants for new boats and new houses. People who previously were only fishing became engaged in farming because of help given by NGOs and government agencies. People were encouraged to join community organizations to facilitate the distribution of aid, thus possibly strengthening local social capital, although a more in-depth study would need to look at the sustainability of those organizations. Thus, in these two Filipino communities, external support seems to have been an important part of coping and adaptation, supporting some households to make major changes to their livelihood activities and in a few cases facilitating transformative change among those individuals and households who moved up the ladder of life. Though one cannot generalize the response of a single woman in Marabut, the situation did enable her to say, in response to a question of whether people were worse off after the crisis: “They were better off after the onslaught of Super-Typhoon Yolanda, because of the external support and assistance given to them.”

The shocks and stresses experienced by households in the case of communities in NE India, though devastating for individuals and households who lost their homes and their livelihoods, did not have the massive destruction and loss of life of Yolanda and did not attract such large-scale external response, both national and international. For the stresses experienced by the Khasi men and women, there was no external support mentioned. For those in the Garo community who suffered the severe flood in 2014, the women’s group confirmed receipt of emergency support in the form of blankets and food rations, household utensils and in some cases cash hand-outs to repair houses.

6.5. Subjective resilience

There have been different approaches to confront the difficult task of documenting individuals’ perceptions of their own capacity to bounce back or bounce forward after shocks and stresses (cf. Jones and Tanner 2015; Bene et al. 2016). In a rapid assessment using FGDs like this study, it is difficult to investigate this important dimension of resilience. Nevertheless, a few insights emerged. The FGDs included both discussions of resilience in the future, which elicited observations from participants about their own perceived capacities, and it included discussions about loss of hope, which is really a form of negative subjective resilience.

The FGDs among the Khasi and Garo communities did not manage to capture much information on these aspects and especially not from men. In response to questions about losing hope in the face of shocks and stresses, Khasi women said that they “don’t give up”. They continue farming every year and, even if the diseases wipe out the potato crop, they buy or borrow seed from neighbors to plant the next year. The Garo women said that “they fight back with all their strength”. They work hard to recover and try their best. This determination leads them to replant the destroyed fields and they devote energy and ingenuity to obtain seeds through borrowing from relatives or neighbors or through purchases in the market. Clearly, the

combination of this personal determination with access to the fundamental asset of crop seed is a potent combination for recovery. Reestablishing crop seed systems has been widely recognized as a key component of post-shock recovery, as was briefly discussed in Section 3 in relation to the paper by Pingali et al. (2005). The eight papers in a volume edited by Sperling et al. (2004) describe a wide range of seed-based rapid interventions in seven African countries in response to natural, economic and conflict-based stresses and shocks. The voices of FGD participants in this brief field study confirm the demand for this key input and a carefully implemented seed-based intervention, including active reliance on and inclusion of the subjective resilience of those directly affected⁹, can be a vitally important contributor to coping and adaptation.

The internalization of key resilience lessons from the experience of Yolanda in Guiuan seems to have contributed to subjective resilience. The women's group talked about their readiness now to evacuate, to "get out of the way", even if it is a low-level typhoon. Although financial savings are assets and they frequently commented on how those on the top step of the ladder suffered the shock less than others because of their savings, the women indicated that they had internalized the importance of building a financial buffer themselves. Diversification of livelihoods is a criterion of resilience widely cited in the literature reviewed as a key response to adverse events. These communities showed what it meant to embrace that criterion in practice and take action to achieve it. The women saw their future resilience in their own efforts to diversify their livelihoods: "For us, we cannot fish during the northeast monsoon because of the strong wind. If we will not farm, we do not have anything to eat." Yet many families did not farm before the typhoon and only depended on fishing. As has been seen, this became part of people's self-perception of what it is to be resilient. The women in Guiuan also commented on the lack of hope or ability to recover. They talked of those households who had lost everything, who received financial assistance for rebuilding, but where the men used it for drink. In Marabut, the women's group was even more eloquent about their own changes, what we can call the growth of subjective resilience. They also commented on their greater alertness, attention to news, readiness to evacuate and determination to maintain food stocks. They also showed their ownership of diversification, commenting on the expansion of farming from homegardens to hillside farming which enjoys greater protection than cultivation near the coast. "We are ready", they say, "our (food, flashlights and medicine kits) are already wrapped...The people are more aware". Asked about what makes people give up or lose hope, they mentioned the depression affecting those on the lower steps of the ladder immediately after the typhoon. They also cited a list of negative characteristics such as lack of love for family, lack of will to live, lack of trust in God, laziness and dependency on 'dole-outs'. They also recognized a pessimism in some people, who are only waiting for another Yolanda to arrive.

The men's group in Marabut was also very animated about what we can call subjective resilience. Talking about the people on the top step, they say those people are "self-reliant...they believe in themselves". For the worse off people on the bottom or second steps, they commented that though they work hard, they are totally focused on supporting their families, "on providing food on the plate" and cannot focus on other matters such as new opportunities for increased income and security for the family. In other words, when struggling to survive, self-belief and subjective resilience is scarce.

⁹ Sperling is also co-author of a cautionary paper that points out that the widespread dependence on seed as the major agricultural intervention in emergency situations can result in seed interventions being subject to misleading myths and misguided interventions. They recommend the need for greater local participation and donor oversight (Sperling and McGuire 2010).

6.6. The role of RTCs in recovery from shocks and stresses

As presented in the preceding sections, the responses of women and men participants in the FGDs have made reference to their dependence on different RTCs in their recovery from shocks and stresses. During the FGDs, the facilitators did not ask specifically about these crops, so that the references were spontaneous. In a final session of the FGDs, the facilitators asked specifically about the role of RTCs in livelihoods and especially their contribution to the capacity of the individuals, households and communities to recover from the shocks and stresses.

In the Garo community in Meghalaya, women confirmed that taro and sweetpotato, cultivated in the jhum field, were the major food crops to be little affected by adverse events. Others that were less affected were mainly condiment crops like chili and turmeric (the latter important as a cash crop, so important also for food security) and pumpkin. Cassava was more vulnerable to adverse events, along with the commercial tree crops. The women also confirmed the importance of the RTCs as staple foods, to “give the amount of fullness and lessen the hunger”. They also commented that RTCs were less eaten now as a preferred food than in the past. With subsidies on rice and lentils, these have become the preferred foods that people like to buy. The men’s group in Garo hills also indicated the important role of cassava and sweetpotato: “Sweetpotato and tapioca help in recovering as well as in coping under adverse situations and the village people mainly depends on these two items...for recovery.” They also commented on the resilience of both sweetpotato and cassava during cyclones, “because they are grown under the soil”. Thus, unlike the commercial tree crops or rice, even cassava, with its higher stand that can be vulnerable to cyclones, can yield food or income, providing the adverse event does not occur early on in the growing cycle.

For the Khasi women’s group, they commented on sweetpotato being very helpful for them in times of need and in terms of recovery. They said that the whole village is engaged in growing the crop and storing the roots underground. In adverse times it is one of the foods that supplements other crops and it is especially important for those on the lower steps of the ladder of life. They intended to keep planting and to increase production. The men’s group agreed and identified sweetpotato as least affected by shocks and stresses. But they also noted that it has a fluctuating market price. They also commented that both sweetpotato and cassava can suffer from drought. It was not possible to probe deeper about the possible drought susceptibility of the sweetpotato and cassava varieties they are growing.

In the Philippines cases, the men in Guiuan indicated that RTCs are important for the community – “we still eat sweetpotatoes and cassava” – and were important in the recovery after Yolanda, as was indicated earlier. They emphasized that RTCs are especially important for those on the bottom step of the ladder, whilst the banana is important for all steps and is widely consumed. The women’s group in Guiuan gave detailed and enthusiastic feedback on all the local RTCs, including swamp taro, cassava and sweetpotato: “We nurture our root crops because of their value”. They underlined the importance of the short growing cycle of sweetpotato, the daily use they make of both roots and leaves, and how they mix them with other foods. They praised the versatility of cassava as a cash and food crop with processing options, and also its resilience in the field. The weaknesses of these crops include their susceptibility to water-logging (in sea water) and the long growth cycle of swamp taro and cassava. In Marabut, the women’s group was also detailed in their comments on the strengths and weaknesses of RTCs, including their versatility as both starchy staple when rice is not available and use of the leaves as a tasty vegetable, and also of skins and peel as pig feed. They see RTCs as key alternative food sources when they are lacking rice, such as during and after the typhoon, but also in the current situation where rice fields are being converted to commercial and residential use. Since there are almost no rice paddies in the two

locations, they see an increase in importance for RTCs, in the case of shocks, but also within their agri-food system. For the men in this location, they also see RTCs importance, despite the susceptibility of cassava to strong winds and problems of sweetpotato during the rainy season. “These RTCs have a big role in our life since we don’t have coconuts anymore, we get our food from RTCs. Sometimes we sell them to get money.”

7. Conclusions

This paper began by reviewing a selection of the extensive literature on resilience, its disciplinary origins and especially the way the concept has been used more recently in relation to recovery from disaster and in assuring food and nutrition security. From its use to describe engineering systems that are close to equilibrium, the concept evolved to characterize non-linear systems far from equilibrium in ecology and later, in social-ecological systems where resilience derives from the complex interactions of ecosystems and social systems.

Drawing on this literature and also on earlier food security work by FoodSTART, a provisional conceptual framework was proposed to help understand the relationship between shocks and stressors and the social-ecological system. For the specific purposes of this review this is characterized as the agri-food system made up of interacting households with their food access, assets, knowledge and social capital, and more or less diverse and robust agro-ecologies. Building on this, a framework was developed and applied for analyzing the resilience of the agri-food system and the role of root and tuber crops in this resilience. The framework envisages that shocks and stresses can directly lead to negative food security outcomes such as through the destruction of crops due to extreme weather events, but these outcomes can be mitigated through the agency of individuals, households and communities. Agency contributing to agri-food system resilience exists in different forms in relation to adverse events: preparation ahead of the event; coping with the immediate and subsequent effects of the event; adaptation to the new conditions produced by the event; or transformation of elements of the agri-food system for recovery or even improvement of the system.

The review of literature on different agri-food systems in the Asian region identified the key characteristics and vulnerabilities of these systems and the important functions of roots and tubers within them. The ubiquity of root and tuber crops among ethnic minorities practicing shifting agriculture throughout the tropical and sub-tropical hill areas of Asia can be understood because they are hardy, suitable for continuous harvesting and make a dependable contribution to household food and nutrition. Roots and tubers, especially cassava and potato, also have played significant roles in the widespread transformation of shifting systems into more commercial, permanent field agriculture. Roots and tubers are also important rotation and relay crops in lowland agri-food systems in Asia, including in coastal areas, and are widely cultivated in rural and urban homegardens that are almost ubiquitous in the region. This literature, which was analyzed through the lens of the agri-food system resilience framework, also provided evidence of the important contribution of roots and tubers to mitigating the effects of different kinds of climate change-related stresses and shocks on these agri-food systems and contribution to system adaptation. The paper also presents and discusses the specific characteristics and traits that make these crops particularly tolerant or resistant to shocks and stresses (especially abiotic stresses like heat, drought, soil salinity and water-logging and shocks like typhoons/cyclones) and important contributors to post-disaster recovery (for instance, due to the possibility of piecemeal harvesting and their short growing cycles).

In order to validate the findings from the literature review about Asian agri-food system resilience and the role of roots and tubers within it, a ground-truthing was conducted through field studies in NE India and central Philippines. This provided access to the voices of women and men who faced different types of shocks and stresses and allowed a better understanding about how they responded, including the role played by RTCs in their responses to the adverse events. It was possible to go beyond homogenous household and community

responses to shocks and stresses through differentiating perceptions in terms of genders and socio-economic status. Whilst those better off were often more prepared and more able to respond because of greater asset endowment, some kinds of stresses, such as livestock related diseases in East Khasi Hills, affected the better off more severely. The paper presents examples of adaptation and even transformation occurring among households with different socio-economic status. However, it was not always easy to differentiate between types of agency deployed in response to crises, in other words between coping and adaptation and transformation. The case studies also showed differences in responses both within the environments selected and also between them, especially in terms of the level of post-disaster assistance received and the self-characterization of responses by different socio-economic groups.

The views of the farming households involved in the field study support both the technical and the agro-ecosystem literature. Root and tuber crops play a hugely important role in both highland mixed systems and in coastal systems in Asia, agri-food systems which are among the most vulnerable to climate change. These crops contribute to the robustness and diversity of agro-ecologies and strengthen preparedness, coping and adaptation strategies of households.

Furthermore, members of all the communities studied confirmed the well-known fact that the availability of seeds is a key ingredient for agricultural recovery. It was also evident from the literature and the field studies that the short growing cycle of many roots and tubers and their rapid production of macro- and micro-nutrients make them prime candidates for seed distribution to enable faster recovery and, possibly, the chance for households to even bounce forward. However, as was noted earlier, seed distribution activities need not only to be well-intentioned but also appropriately designed, with local participation and careful monitoring in order to avoid undermining local seed systems and businesses and causing worse problems than the ones they were meant to fix.

Drawing on the findings presented in this paper it is possible to provide some recommendations to several stakeholders. First, in spite of the robustness of roots and tubers in the face of climate-related shocks and stresses, there is ample room for further enhancing the contribution of these crops to more resilient agri-food systems through targeted varietal development. This can be done by applying the six-step approach recently proposed by the CGIAR Research Program on Roots, Tubers and Bananas for climate-smart breeding (Thiele et al. 2017). Research can also contribute by providing solutions and recommendations for climate-smart agronomic practices such as the ones disseminated through the Climate-Smart Villages promoted by the CGIAR Research Program on Climate Change, Agriculture and Food Security. Second, the awareness and relevant capacities of extension staff, development practitioners and civil society organizations should be strengthened to effectively contribute to adaptation and wide-scale uptake of available innovations and technologies. Third, the private sector can play a key role in creating a market pull for these often-neglected crops. Mechanisms should be established to facilitate access to innovations, engagement with smallholders – who are still the backbone of RTC production, processing and consumption – and funding modalities, including value chain financing. Finally, governments and donor agencies should recognize that roots and tubers have so far received just a fraction of the attention paid to other important commodities, such as cereals, legumes and livestock. Increased investments and innovative collaboration modalities are required – such as the research-development partnerships supported by IFAD through the FoodSTART+ project – to unleash the full potential of these crops to contribute to improved nutrition, gender equality, youth employment and improved adaptation to climate change.

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Annexes

Annex 1 Keywords used for literature search

Keywords were elaborated in an iterative way, drawing on initial key documents in each literature 'field'. The fields derive from the terms of reference of the review.

1. History and conceptual dimensions of resilience

- Agri-food system
- Ecology AND resilience
- Food security AND resilience
- Food sovereignty
- Food stability
- Food system
- Resilience. The term was combined with other keywords listed below
- Resilience AND climate change
- Resilience AND disaster
- Resilience AND emergency
- Resilience AND gender
- Resilience AND nutrition
- Resilience AND social capital
- Subjective resilience
- Social-ecological system
- Vulnerability

2. Agricultural systems in Asia that include RTCs

- Anthropology AND Northeast India
- Cassava AND Asia
- Coastal agriculture AND Asia
- Conservation agriculture
- Homegarden
- Homestead garden
- Indo-Gangetic Plain AND potato
- Post-rice
- Rootcrops AND Asia
- Secondary crop
- Swidden AND Asia
- Swidden AND Northeast India

- Shifting agriculture AND Asia
- Sweetpotato AND Asia
- Taro AND Asia
- Tuber crops AND Asia

3. Genetic, agronomic and post-harvest characteristics of RTCs relevant to climate change

The following traits were combined with the different RTCs

- Climate change
- Drought tolerance
- Heat tolerance
- Salinity tolerance
- Soil fertility
- Micro-nutrients
- Storage

Annex 2 Background, approach and tool used in field assessments

Background

The first phase of FoodSTART was launched with the purpose of promoting the role of roots and tuber crops (RTCs) in the farming systems of the Asia-Pacific region to “build a more diverse and robust regional food system in the face of possible shocks and climate change” (CIP 2010). One objective was to understand and document current roles of RTCs in contributing to food security, including through increased income generation. To systematically approach this objective, the FoodSTART team developed a food security conceptual framework. This framework considered the four dimensions of food security: availability, access, utilization and stability, as set out in the FAO definition (FAO 1998). In undertaking the general assessments of RTCs and food security and in the follow up thematic studies, the project focused primarily on the contribution of RTCs to increasing overall food availability, whether RTCs offered producers greater food access and then about the extent of utilization of RTCs in terms of cultural patterns of food preparation and consumption and nutritional benefits. A lot less attention was focused on the fourth dimension, food stability over time. Part of the difficulty with food stability is its dual meaning as food vulnerability – susceptibility to becoming food insecure – and food resilience – the capacity to respond successfully to agri-food system and environmental stresses and shocks. Another difficulty is that whereas food availability, access and utilization can be studied as outcomes at a particular point in time, the lack of sufficient elapsed time in the assessments and thematic studies of FoodSTART phase 1 made it difficult to examine food stability.

The second phase of FoodSTART (FoodSTART+) has sought to target food stability head on through its overall purpose to promote the role of RTCs in reducing food vulnerability and enhancing resilience of poor women and men agricultural producers and consumers in the Asia-Pacific. Given the increased threat in the region from a range of external environmental, biophysical and socio-economic risks and shocks, including deforestation, typhoons and flooding, as well as financial and political crises, an urgent need was identified to determine how RTCs can contribute to more stable food security over time through adaptive management strategies for enhancing food resilience.

Whilst scoping studies with the IFAD investment projects in the FoodSTART+ sites have identified intervention activities that can increase the contribution of RTCs to food resilience, systematic evidence across the sites for this contribution would only be available through an *ex-post* impact assessment of the interventions after the end of the project. The expectation that RTCs can achieve increased food resilience is built into the FoodSTART+ project, so it is important to examine evidence for the role of RTCs in food resilience during the current project and ahead of a possible *ex-post* assessment. A review of literature on food resilience in the Asia region was conducted to identify existing evidence of the contribution of different crops, with an emphasis on RTCs.

The literature review has mostly captured researcher perspectives on the role of RTCs in agri-food system resilience. Some of these studies may report on and interpret the perspectives of farming households, but we deemed it helpful to complement the results from the literature with some limited direct assessments with communities dependent on the agri-food systems under study. A well tested methodology of focus group discussions (FGDs) is available and single-sex FGDs were carried out in key locations in NE India and in Central Philippines to explore how the women and men of these communities experience different kinds of stresses and shocks affecting their well-being and how different sectors of the community respond, including through the deployment of RTCs.

The methodology used in the field assessments to ground truth some of the findings of the literature review derives from a study of gender norms and agricultural innovation undertaken by multiple CGIAR Research Programs between 2014 and 2018 (Petesch et al. 2018a; Petesch et al. 2018b). Some elements of the methodology were adapted for the field assessments. These were introduced via a training session for the teams that facilitated and took notes during the FGDs.

FGD scope and participants' selection

The focus groups explored men's and women's perceptions of and experiences with:

- Their own circumstances, their resources, their agricultural roles and decision-making.
- Environmental, socio-economic and humanitarian stresses and shocks that have affected their communities over the past 10 years.
- The ways these stressors and shocks have affected different groups within the community, including between women and men, young and old and low income and better off households.
- How different groups within the community have responded to these stressors and shocks, including through agricultural adaptation and transformation and whether RTCs have played a role.
- The groups existing in the community and institutional connections outside the community and how these have contributed to overcoming stresses and shocks
- The cultivation of RTCs and characteristics that can contribute to responding to shocks and stresses.

The sampling frame for the FGDs was designed to learn from the experiences of men and women engaged in agricultural activities. In each community (2 in Meghalaya, India; and 2 in Eastern Visayas, Philippines), two FGDs were conducted:

- A group of 8 to 10 men involved in farming, with a mixture of ages from approximately from 20 to 55, with representation from both low income and better off families.
- A group of 8 to 10 women involved in farming, with a mixture of ages from approximately from 20 to 55, with representation from both low income and better off families.

Under normal application of this methodology, there would be separate FGDs for youth and adults and for better off and lower income members of the local population. The available time and resources for this fieldwork did not permit this number of FGDs, so we attempted to tailor questions for youth members of the FGD and distinguish some answers and questions as between the better off and lower income participants.

FGD tool: Guide questions and instructions for FGD-based complementary assessment (approximate time 2.5 - 3 hours)

Introductions and purpose

Participants are asked to fill in a roster when they arrive for the FGD.

A completed roster should be the first page of the documentation for the focus group.

Focus Group: Resilience									
Female/Male (circle)									
Country/Province or State:									
District:									
Name of the community:									
Facilitator:									
Notetaker:									
FGD members (family name not needed)	Age	Ethno-religious group*	Relationship to household head	Marital status**	Level of education completed***	# of children	# of household members	Primary occupation	Secondary occupation
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									

HELP PARTICIPANTS PUT THEIR NAME ON PREPARED SQUARES OF PAPER TO STICK ON SHIRT/DRESS WITH MASKING TAPE. FACILITATOR AND NOTETAKER AND GUESTS (DIEGO, SHANPRU AND GORDON DO THE SAME)

FACILITATOR AND DOCUMENTER INTRODUCE THEMSELVES AND ALSO SUPPORT STAFF (WHOEVER IS THERE) AS PEOPLE SUPPORTING THE STUDY

Please read: **Thank you for joining us today. We are going to be discussing men’s and women’s experiences and perceptions of different types of adverse events affecting your well-being and especially in the way you make your living through agriculture. Those events or disruptions can be sudden shocks, those short and unpredictable adverse events like extreme weather, floods, price collapse or spikes of your main crop, or conflicts, which affect your livelihoods; they can be medium term stresses that may last several months and be recurrent, like reduced rainfall or recurrent pest problems or low market demand; and they may be long term trends that occur gradually or incrementally, like build up of salinity or decline of soil fertility or changing prices for crops. We want to discuss with you how you have responded to those different events and especially if your responses have included changing your agricultural practices. We will also be discussing whether your local relationships with relatives and neighbors have been important in this**

response, or your links with external agencies. This focus group is part of a large study being conducted with separate groups of women and men in other communities in this country and in other countries.

Your participation today is voluntary and confidential. We will not be using your names or the name of this community in any publication with the information that we collect today. We request that you respect the confidentiality of the others participating today by not repeating outside this room anything that was said during the discussion. We hope that each of you will feel free to express your opinions fully and share your own experiences with the topics that we will be discussing. We are inviting all of you to contribute your ideas, not just one or two people. You are of course each free not to answer any question and to leave the discussion whenever you like. However, we very much hope you remain for the entire discussion and enjoy reflecting on many of our questions. Your views and experiences are very important to us. We cannot promise that you and your community will benefit directly from this study, but the information that we are collecting will help to improve agricultural research and development activities in Region 8.

Are there any questions before we begin?

Session 1 Knowledge of shocks and stressors in past 10 years (ABOUT 25 MINUTES)

1a What have been the main shocks and adverse natural, economic or social stressors or trends that have negatively affected your household and community over the past 10 years or so, that have affected your well-being in different ways?

[Facilitator may need to prompt about agriculture-related events if these do not come out strongly. May also need to prompt for medium term stresses and long-term trends.]

[Notetaker will list these events and trends on a large sheet of paper]

[Note to facilitator: In relation to the events listed on left side of the large paper, participants are given three stickers and asked to use their stickers to highlight the three most serious negative events that caused the most disruption to their lives. The facilitator writes up the three events with the most stickers on a second sheet of paper next to the full list. These are written up at the top of three columns. Note that they can identify the same type of events eg hailstorms, that occurred at different times].

1b What kind of disruption did these events cause in the community and to your well-being? Effect on your agriculture? On household food security?

1c Which of your main crops were most effected? Which of your crops were least affected by the different events?

[Note to Facilitator. On the second sheet of paper, the three most important negative events are at the top of three columns. Under each column, the most affected crops are listed for the three events. Under that, the three least affected crops are listed].

1d Briefly I also want to ask you about some of the disruptive events that were not sudden shocks, but were stresses that happened over time. How did they affect you and your family?

[Note to facilitator: please select one medium to long term stress or trend (eg from among the long list (things like increasing pest problems, depletion of soil quality, declining prices), if possible agriculture-related. If no medium to longer term adverse events/trends are selected, , prompt them to identify one such stress and to comment briefly on its effect on families].

1e3i Have you noticed that there has been any change in the frequency of shocks or stresses over the past 10 years?

Session 2 Household characteristics and livelihoods diversity (ABOUT 40 MINUTES)

[Read:] In this session, we will be discussing the different types of people who live in your village, and introducing an activity called the Ladder of Life. This activity is designed to provide a picture of the different wellbeing groups that live in the village and their characteristics. We will explore how and why some individuals and households here are able to get ahead—and also how and why people sometimes struggle and fall back. We will then discuss the different adverse events and trends that have affected the village, and how they have affected the different well-being groups on the ladder.

[Note to Facilitator: lay three large sheets of white paper on the ground to form an elongated rectangle. This is going to be the ladder. When the discussion begins about those on the top step, encourage one of the group to write some characteristics discussed on the paper. This will also help the notetaker later]

2a First I would like you to tell me about local people at the top step. How would you describe the men and women who are the best off of the village? How do they live? How can you tell that a person or household is the best off?

[Note to facilitator: Allow group to characterize in their own way those on the top step of the ladder. If they do not mention household and agricultural assets try to get them to describe, especially productive assets like land, equipment, types of crops and seed sources, hired labour etc. Also income sources, main and other sources]

2b Next, we will move all the way down to the very bottom step, which we'll call step 1. How would you describe the people here who live at the bottom—or the worst off in the community? What is a person's life like who is on the bottom step or step 1? How do they live. How can you tell that a person or household is the worst off?

[Note to facilitator: proceed in same way as with the group at the top]

2c Let's move on. What about people who are on the step just above the people who are at the bottom? How would you describe individuals and households here at step 2?

2d Now, let's move up from step 2. Does this community have a step between step 2 and the highest step? [If so] How would people living on step 3 be described?

[Note to Facilitator: Keep inquiring about additional steps until the best off on the top step is reached. Once the ladder visual is complete, number each of the steps so that step 1 is the bottom step or worst off. Numbering the steps will make the following discussion easier.]

2e Now, let's remember the earlier discussion of the three major adverse events that have affected the community. Have the different events affected those on the different steps of the ladder in the same way? Or in different ways? For some of the adverse events, can you describe the different ways they disrupted the life and well-being of those on different steps of the ladder?

2f Did medium term stresses or long-term trend affect some of the steps of the ladder differently?

[Note to Facilitator: If medium term stresses/long term trends like rise in temperature or changing rainfall patterns already are among the three prioritized events in 2e, please skip this question. Make sure that this

discussion includes agriculture-related adverse events and also disruption to agricultural activities. If participants do not mention it, ask about disruption to different types of crop and livestock/aquatic production. If RTCs are not mentioned, you can ask about disruption to these crops]

Session 3 Responses to adverse events (ABOUT 40 MINUTES)

[Note to facilitator: Please consider the discussion in questions 3a to 3c in terms of *preparedness, immediate coping after the event and then recovery*. Invite individuals to select one the most important events earlier identified and talk about their response in terms of preparedness, coping and recovery. If not included in the voluntary responses, ask about any changes in agricultural practices. Ask about changes in food intake in 3b and 3c. If not mentioned, ask about any changes in cultivation and consumption of RTCs+B as part of response].

3a Now we will turn to discussing responses by members of this community to these different adverse events Please identify one of the three most important adverse events identified earlier and tell us how it affected you and your family. Were you at all prepared for the event? In what way were you prepared?

3b What in your opinion were the most important types of response which members of the community made to this adverse event

[Note to facilitator: List these responses on a sheet of paper]

[Note to facilitator: From those responses, select some for further discussion. In selection, try to choose ones that are about “coping”, in other words, actions taken to enable families to continue to survive, especially in relation to ensuring family food security. For example, did they change type of food consumed, reduce portion size or skip meals, did they reduce other expenditures? Or take out loans? Choose another for discussion which indicates an adaptation of current practices, for example choice of new crops, expansion of some crops, adding new livelihoods activities etc. And if included, invite further discussion on more radical solutions like migration, shifting out of agriculture Etc].

3c In your responses to the different adverse events, how were decisions taken in your household? Did men and women respond differently? How did you reach decisions about what to do to recover? How were responsibilities distributed?

3d Now we would like to discuss in particular your relations with other people in the community outside your immediate family in the adverse event you just discussed. Who did you turn to? What kind of help did you request? What kind of help did you receive? Do you always turn for help to these contacts, or does it vary?

3e Did the community or your household receive external support to respond to the adverse event? What kind of help and from which organizations?

3f What have you done in relation to one of these events that make you better able to deal with shocks and stresses in the future

3g Now let's turn back briefly to the ladder of life we built up earlier. Were those on some of the steps better prepared? Were some better able to recover than those on other steps? What assets or characteristics were important for responding to adverse events?

3h Did people on some of the steps become worse off, unable to cope or recover? What was the main cause? What makes people give up?

3i Has the accumulation of shocks or stressors, I mean different adverse events occurring at the same time or very close together have different consequences for people on the different steps? What has been the effect of this accumulation of shocks and stresses?

3j How well do you think the community as a whole is able to respond to any future shocks or stresses?

[Note to facilitator: If there is no reference to capacities of individuals or motivation in coping and recovery or their absence, please raise this with the group].

Session 4: Knowledge of resilient crops (ABOUT 20 MINUTES)

4a As a final exercise today, can we ask you more information about the benefits and weaknesses of the main crops identified on the flip chart sheet (question 1c) as most and least affected by the adverse events. What are the reasons for particular crops being seriously affected by the shock or stress? What were the reasons that particular crops were not badly affected?

[Note to Facilitator: For the next question, 4b, answers will depend whether 4a included some RTCs+B as either badly affected or little affected. If it does, use this question to discuss other RTCs+B not mentioned. If no RTC+B were discussed in 1a, use this question to ask specifically about RTCs+B.

4b Now I want to focus especially on the role of RTCs and bananas. How important was the role of these crops for those people on any of the steps of the Ladder of Life in responding to shocks or stresses? What did they contribute?

4c In the past 10 years, has the importance of RTCs+B for responding to adverse events increased or decreased? Why do you think that is?

Thank you for being so generous with your time today and for sharing your views and experiences.

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CIP is a research-for-development organization with a focus on potato, sweetpotato and Andean roots and tubers. It delivers innovative science-based solutions to enhance access to affordable nutritious food, foster inclusive sustainable business and employment growth, and drive the climate resilience of root and tuber agri-food systems. Headquartered in Lima, Peru, CIP has a research presence in more than 20 countries in Africa, Asia and Latin America.

www.cipotato.org

CIP is a CGIAR research center

CGIAR is a global research partnership for a food-secure future. Its science is carried out by 15 research centers in close collaboration with hundreds of partners across the globe.

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For more information, please contact CIP Headquarters. Av. La Molina 1895, La Molina. Apartado 1558, Lima 12, Peru.

 +51 1 3496017  cip-cpad@cgiar.org  www.cipotato.org |  [@cipotato](https://www.facebook.com/cipotato)  [@Cipotato](https://twitter.com/Cipotato)  [@cip_cipotato](https://www.instagram.com/cip_cipotato)
