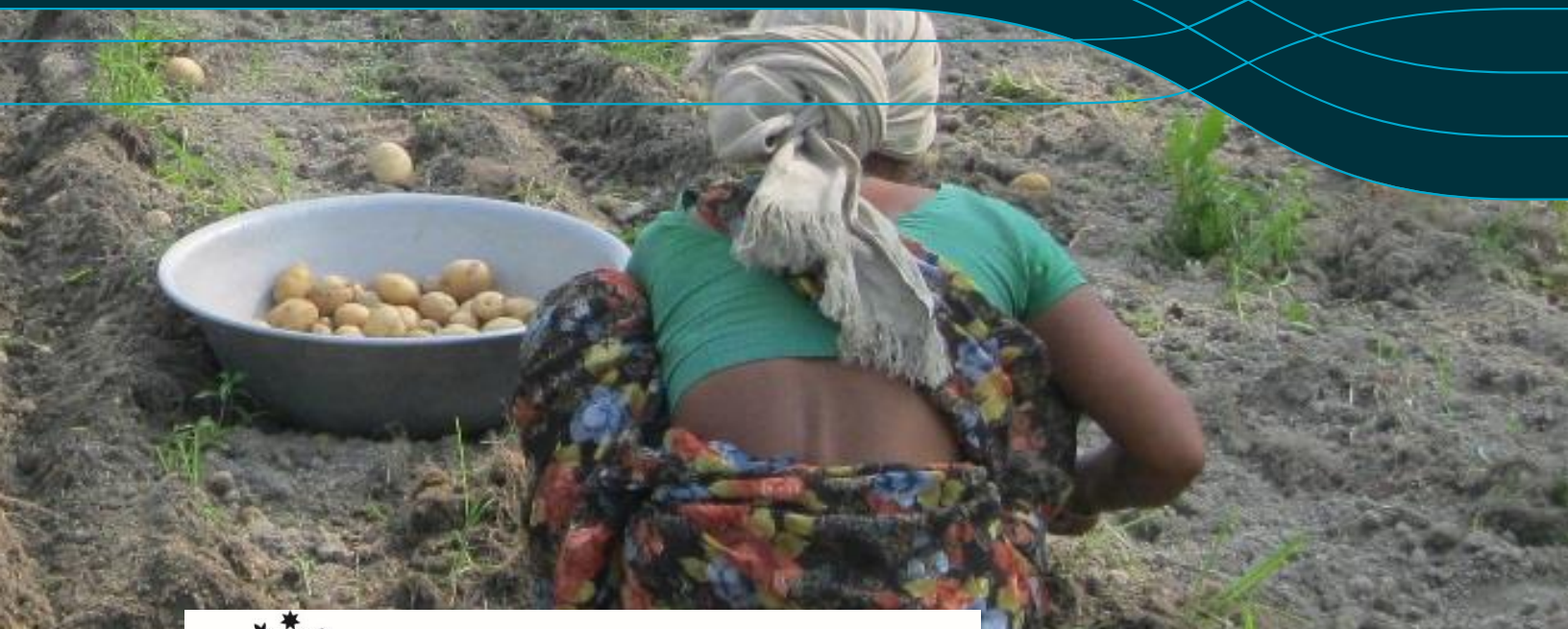
Promoting Socially Inclusive and Sustainable Agricultural Intensification in West Bengal and Bangladesh (SIAGI)

A Synthesis of Risks and Opportunities of Agricultural Intensification in the SIAGI Case Study Areas

Compiled by

The SIAGI team



Australian Government

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A synthesis of risks and opportunities of agricultural intensification in the SIAGI case study areas

Compiled by Wendy Merritt and Serena Hamilton on behalf of the SIAGI team from reports on Activities 1.1 to 1.8 and project team workshops and field visits.

Summary

This report provides a synthesis of factors influencing livelihoods, social exclusion, adverse incorporation and environmental degradation, as part of SIAGI's integrated modelling and assessment process. An overview of the integrated modelling activities undertaken in the first two years of the project is provided. Starting with the conceptual framework, the needs of the SIAGI project included the ability of the framework to: capture a diverse range of issues and processes across multiple scales; describe some level of dynamics and interactions between elements of the system; be scaled up or down in terms of detail and complexity, and be co-developed by team members with a diverse range of disciplinary and experiential backgrounds. A new 'driver-state-impact pathways' framework was developed to meet these needs. This 'driver-state-impact pathways' framework was used to capture understanding of the case studies and serve as a tool for the team to discuss the key risks faced by communities with respect to their underlying causes and wider implications.

The important factors influencing agricultural livelihoods and communities, in terms of constraints and opportunities of socially inclusive and sustainable agricultural intensification, are discussed. While there were several constraints and opportunities that were common across the four villages, including environmental, market, social and political factors, there were also several case specific factors that are important. The compiled findings highlight the importance of an integrative approach to assessing risks, given the multifactorial, interwoven and context-dependent nature of processes.

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1 Introduction

In the project proposal for SIAGI, the synthesis of factors influencing livelihoods, social exclusion, adverse incorporation and environmental degradation (Activity 1.8) was framed as a quantitative risk assessment. This activity directly informs the activities specified for Objective 2 of the proposal, and shapes decisions around the selected modelling approach and model development process. Two considerations have led to the redesign of activities 1.8, 2.2 and 2.3 in the project workplan: (a) the need for a conceptual framework that was clear and flexible enough to meet the needs of the SIAGI project team and would allow the scaling up or down (as required) in terms of detail and complexity, and (b) SIAGI's commitment to the principles of ethical community engagement in October 2016 and the implications of this commitment for the process and methods for data gathering and analysis.

The conceptual framework developed for the SIAGI project, and the reasons for doing so, are described in Section 2 of this document. An overview of the integrated modelling activities undertaken in the first two years of the project is given in Section 3. Section 4 contains a synthesis of the constraints and opportunities for landless, tenant, women-headed and marginal households to engage beneficially in agricultural intensification. This section draws on the output reports from the activities 1.1 to 1.6 as well as conceptual modelling activities undertaken by the SIAGI project team. The report concludes with a brief discussion of how the understanding gained from activities 1.1 to 1.8 (to this point in time) will shape the integrated modelling and broader SIAGI research for the duration of the project.

2 Reframing the 'risk assessment' to 'driver-state-impact pathways'

This section draws upon a conference paper presented at the 22nd International Congress on Modelling and Simulation (MODSIM2017) in December 2017. The full paper can be accessed at https://www.mssanz.org.au/modsim2017/K5/hamilton.pdf (accessed 04/06/2018).

Research and practice in international development needs to transcend traditional disciplinary and sectorial boundaries. Not only are multidisciplinary teams essential to address the broadening scope of relevant issues, these teams also need to work together to generate deeper knowledge of the network of issues (Tress et al. 2007; Bark et al. 2016). In such complex projects, integration and true transdisciplinarity can be constrained by several challenges, including differences in theories, methods, terminologies and the research interests of team members. These differences need to be moderated and pathways of integration and collaboration need to be facilitated in order to exploit and leverage the expertise of the research team (Klein 2008).

In SIAGI, integrative frameworks and modelling are an intended pathway for integration and collaboration. Conceptual modelling was used as a tool for the early scoping and problem formulation phases for activities 1.8 and 2.2 in the SIAGI project workplan. Conceptual models provide a schematic of a how a group (or individual) understand a system to work. Argent et al. (2016), amongst others, advocate for them to be used as a platform to generate shared understanding and learning amongst multiple disciplinary experts.

In the initial stage of the conceptual modelling, some common frameworks were screened for their suitability, including risk assessment frameworks, the sustainable livelihoods (SL) approach, and the Driver-Pressure-State-Impact-Response (DPSIR) framework (See Section 2.1). None of these were considered adequate for conceptualizing the socioecological systems investigated by the SIAGI project. Thus we developed a framework to elicit and communicate understanding about complex problems and systems (See Section 2.2). Although designed for the SIAGI project, it is generic in structure and has been adapted for application to climate risk management in mining value chains (Lim-Camacho et al. 2017).

2.1 A brief overview of existing frameworks

At a meeting with the Australian partners in Brisbane in 2016, it became clear that we had different ideas about how "risk" is defined and assessed; there are similar issues with some of the framings commonly used in the environmental or development fields (Table 1). Ultimately, the team agreed that adopting a risk-based conceptual template (as originally proposed) may well lead to the study system being framed negatively, which in turn might present impediments to identifying opportunities for positive change with the communities. Furthermore, the high interconnectivity of the risks in SIAGI means that they cannot be assessed meaningfully in isolation from one another, as required in standard risk assessments.

Two other commonly used frameworks are the SL approach[1] and the DPSIR framework[2]. The SL framework was considered useful for identifying key aspects of livelihoods to further investigate within SIAGI; however we need to extend conceptualisation further to capture social processes and other indicators of change. Applying the DPSIR framework on its own was not a viable option given the focus of SIAGI on social interactions and dynamics.

Table 1 Three common frameworks used to structure agro-environmental research for development

Framework	Examples of challenges or limitations with respect to SIAGI

Risk Assessment (RA) frameworks	• 'Risk' is often used interchangeably to mean several concepts (Brooks 2003), e.g:
	  ○ as a product of likelihood and impact
	  ○ as in the likelihood or probability of something occurring
	  ○ as in the hazard or source of harm itself (e.g. climate change risk, flood risk)
	  ○ as in the intersection of assets, threats and vulnerabilities
	• Differences in language may well cause difficulties in communication
	• The nomenclature for risk assessment tend to be value-laden concepts

Sustainable Livelihoods (SL) approach	• The focus on livelihoods could mean other dimensions of people's lives and well-being are ignored or overly simplified • Potential for complexity and alienating language (Smyth and Vanclay 2017)
Driver-Pressure-State-Impact-Response (DPSIR)	• Confusion amongst the category terms used in the framework (e.g. driver vs pressure, state vs impact) resulting in its misapplication and misunderstandings among scientists, policy-makers and other stakeholders (Oesterwind et al. 2016) • Rigid template restricts the types of problems that it can describe (e.g. it cannot represent moderately complex problems such as an activity that results in multiple pressures, or multiple activities that result in a similar impact) (Patricio et al. 2016). • Social interactions and dynamics are not captured and all socioeconomic processes are effectively lumped into the external factor, 'the social system'(Binder et al. 2013)

2.2 Our conceptual framework template

The SIAGI project required a conceptual framework that could:

- capture a diverse scope of issues and processes across scales,
- describe some level of processes and dynamics and interactions between elements of the system,
- be scaled up or down (as needed) in terms of detail and complexity, and

[1] The SL approach is centred on livelihood assets, of which there are five main categories: natural capital (e.g. land, water), human capital (e.g. skills, knowledge), social capital (e.g. social networks), physical capital (e.g. housing, transport) and financial capital (e.g. income, savings, access to credit). These assets are placed within the external environment ("the vulnerability context"), which includes trends (e.g. economic trends, changes in politics), shocks (e.g. conflict, death in family, weather) and seasonality (e.g. changing prices, production cycles). Under this framework, a livelihood is considered sustainable if it is able to cope with stresses, respond to adverse changes, and maintain or improve its capabilities and assets under all five capitals (Scoones 1998).

[2] The DPSIR framework is used to describe policy responses to address impacts of human activities on the environment. Interactions are described in terms of a casual chain starting from the **driving** force (e.g. human activity, economic sector), to the **pressure** (e.g. excessive resource use, waste), to the **state** of an environmental resource (physical, chemical, biological), then its **impact** on the environment (ecosystem, human health) and, finally, the policy **response** (e.g. policy measures, target setting, market signals).

- be co-developed by team members with a broad range of disciplinary backgrounds and experiences.

To address the latter point, in particular, we wanted unambiguous terms that did not impose certain values or discipline-specific interpretations. For example, terms such as threat, risk and vulnerability can have negative connotations and so the use of more neutral terms should help us represent opportunities and more positive directions of change. It should also help avoid imposing certain perceptions onto others. Prior to developing the framework, members of the SIAGI team had noted that what is viewed as a risk or disbenefit by some may be viewed as an opportunity or benefit by others. The neutral language of the framework is intended to capture such nuance and have utility for cross-cultural contexts and teams.

The framework is shown in Figure 1; processes are described in terms of a *change in state*, the direct and indirect drivers of this change, and the direct and indirect impacts of the change. The categories and their links are generic in nature and are not spatially or temporally overt. This gives flexibility to represent multiple types of processes simultaneously. A *change in state* can include any increase or decrease in tangible and intangible assets, capabilities, capacities, or behaviours. Additional factors may increase or reduce either the magnitude of change or impact, or the capacity of the subject to avoid, cope with or adapt to the specified change.

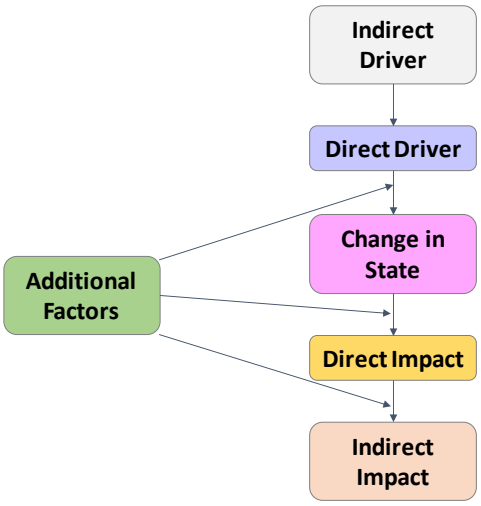

Figure 1 The conceptual framework template for assessing system processes and changes.

Various knowledge elicitation processes (e.g. surveys, interviews, workshops) can be used to populate the template (for examples see sections 3.1 and 3.3). The template is modular in nature allowing diagrams for different concepts to be aggregated into a conceptual model with multiple processes and complex pathways of influence. From here on, this template will be referred to as the 'driver-state-impact pathways' framework.

3 Integrated modelling activities (Year 1 and 2)

This section draws upon: a SIAGI blog (https://siagi.org/2018/04/26/integrated-modelling-in-siagi/), the v1 conceptual models (https://www.mssanz.org.au/modsim2017/K5/hamilton.pdf), the v2 conceptual models and 2018 trip reports (Merritt et al. 2018; Carter et al. 2018).

To date, the focus of the SIAGI integrated modelling activities has been on 'Scoping' and 'Problem framing and formulation' phases (see Figure 2). There has been an ongoing process of understanding and capturing the key system components and variables, and their linkages, as well as determining the scope of the model (e.g. What issues will it capture? What type of questions will the model address?). This has been a deliberately extended process to ensure the most appropriate model type is selected. A timeline of key activities and outputs is shown in Figure 3.

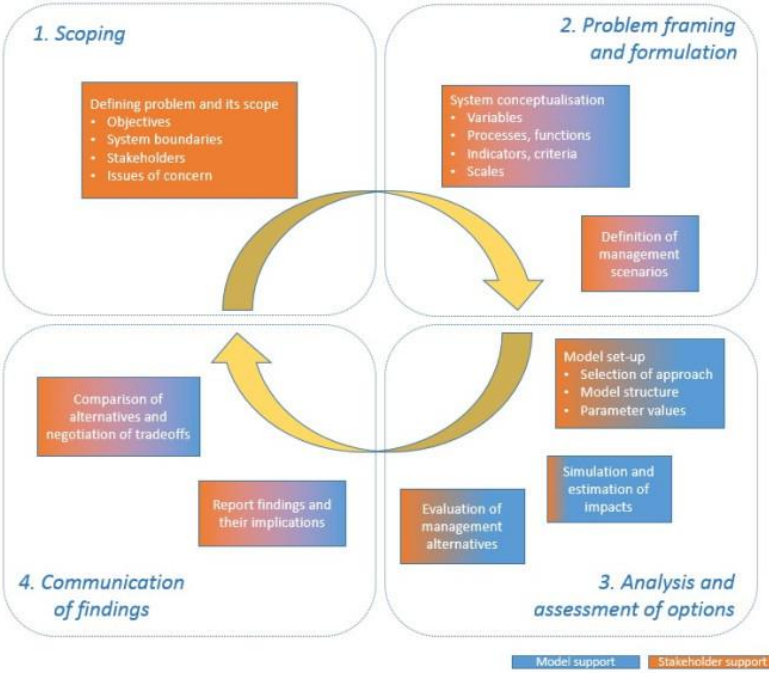

Figure 2 The steps and four phases of the integrated modelling process (Hamilton et al. 2015).

3.1 Initial conceptual models

In July 2016, we surveyed our project partners to elicit their early understanding of up to five key issues that affect the rural communities they work with. For each issue, we wanted to know who it affects and how, the drivers and flow-on effects, and factors that improve the capacity of households to avoid, adapt to or cope with negative impacts. By September 2016, we developed the first version of conceptual diagrams which highlighted the interrelated nature of the issues and the complex pathways that determine (e.g.) food security, financial and health outcomes. This exercise highlighted the challenges that the SIAGI team faced with respect to differences in terminologies, theories, methods and/or research interests of members. This led to the development of the 'driver-state-impact pathways' framework (Section 2.2) to structure issues, risks and opportunities within the first version conceptual models.

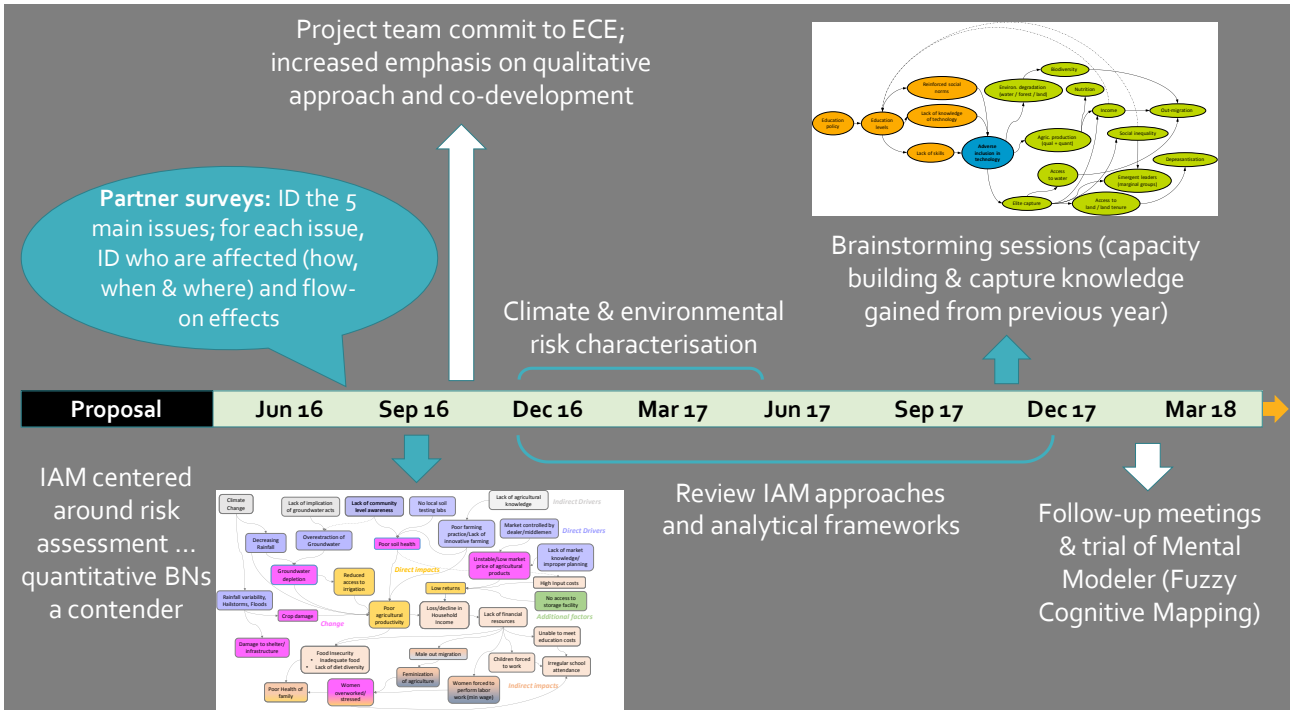

Figure 3 Timeline of key activities and outputs for Activity 1.8 and Objective 2 activities (Year 1 and 2).

3.2 Climate and environment risk characterisation

The report for this activity was a milestone submitted as Appendix 9 to the 2017 Annual Report

A desktop analysis of environmental risks and opportunities in the Dhaloguri, Khatail, Sekendarkhali and Uttar Chakowakheti case studies and regions

- identified the critical biophysical drivers and processes impacting communities,
- presented an analysis of the climate risk in terms of rainfall variability, and
- synthesized the major environmental risks and opportunities in the case study areas.

The report drew upon scientific literature, observations of the project team and their discussions with the local community, sister project trip reports, and available climate and environmental data. It was framed in terms of impacts on key land- or water-dependant livelihood activities. While there are similarities in the environmental setting of all four case studies, including their humid tropical climate, their susceptibility to monsoon failure or droughts, the low fertility of their soils and underdeveloped groundwater resources, there were also contrasting features among the villages. In particular, being on the coastal zone, the Bangladesh villages are subject to problems of saline water and soils, waterlogging and exposure to storm surges and flooding. Uttar Chakowakheti borders a major river, which threatens the village with flooding after heavy rains, and a forest, which is a source of livelihood for some of the community but also habitat to wild animals that can threaten lives, crops and housing. The biophysical characteristics of the villages, overlayed with their social and institutional setting, present a number of potential constraints and opportunities to intensifying agricultural development and improving crop yields (analysed further in Section 4).

3.3 Driver-state-impact pathways

In November 2017, the SIAGI team used the 'driver-state-impact pathways' framework to capture the knowledge and learnings from the preceding year, and inform revisions to the conceptual models, a precursor to the integrated models. The first activity was a whole-of-group brainstorming session to identify the spectrum of 'risks' that our beneficiaries encounter in the context of agricultural intensification. We then worked in five sub-groups – policy, market, environment & climate, health, and social – and brainstormed driver-state-impact pathways around each of the topics. Due to time limitations, for expediency we aggregated direct and indirect drivers and impacts, and focus on the key 'risk(s)'. This capacity building exercise has helped the team to think in terms of systems, interconnections (including indirect drivers and impacts) and feedbacks, and appreciate the complex nature of these risks, which have multiple drivers, impacts, and pathways of impact.

Recurrent themes or concepts for each of the topics related to *Elite capture of water* (and therefore *Access to water* by marginal households), *Social structure* (or systems), *Agricultural production*, *Poverty*, *Nutrition*, *Income* and *Out-migration.* Whether these were conceptualized as drivers, states or impacts depended on the lens the sub-groups explored. The exercise highlighted the complexity of scales relevant to the SIAGI program of research; impacts are mostly at household to community scale but they are influenced by drivers operating at a range of scales (Figure 4).

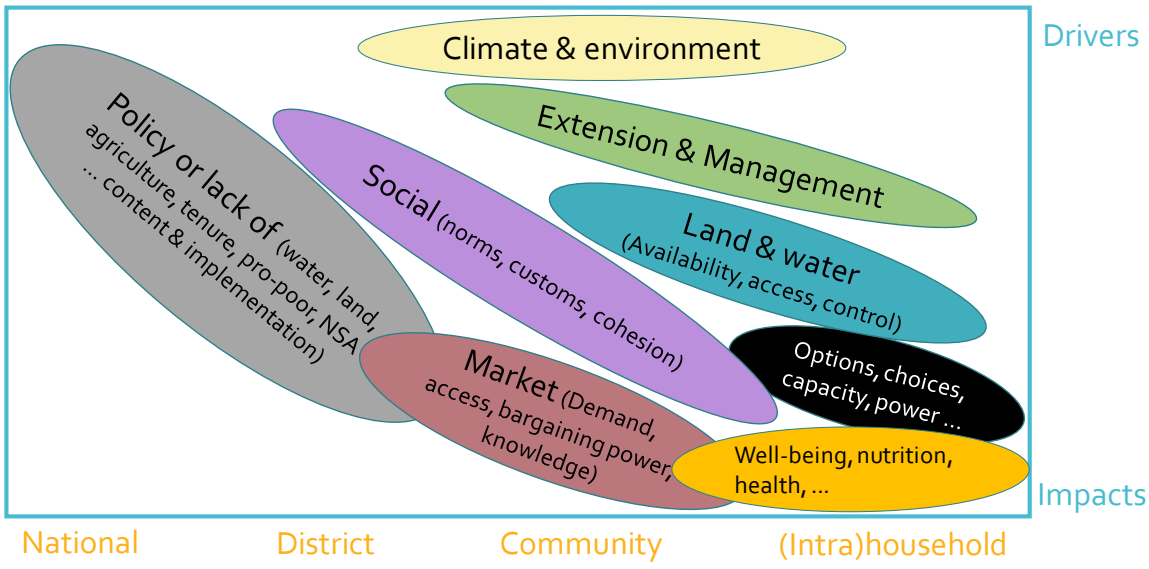

Figure 4 Cross-scale issues implicitly represented in the driver-state-impact pathways developed by the SIAGI team

3.4 Refining concepts and identify enablers, magnifiers and constraints

In February 2018, Wendy Merritt travelled to Jalpaiguri and Dhaka to meet with some of the Country Partners. The primary aim of this trip was to clarify concepts from the conceptual mapping exercise undertaken in November 2017, and to map constraints and enablers to achieving desired outcomes for SIAGI target beneficiaries. The trip also provided an opportunity to trial a free web-based software tool called Mental Modeler for use in SIAGI (for further details see the companion report by Merritt and Hamilton, 2018 and http://www.mentalmodeler.org/, accessed 27/06/2018), and see how it may fit with the IIT and BAU PhD research. Topics with Pulak Mishra (IIT) focused on sustainable livelihood capitals and how we could capture changes in them in SIAGI. At CDHI, we explored CDHI's role as facilitators and advocates for the communities, how the farmers' aims (or demands) have changed over the life of the ACIAR projects, issues around sustainability, the initiation of the collectives and their change over time, and how information from the discussions could translate into the integrated modelling activities within SIAGI. In Dhaka, we tracked how the Water and Silt Management Committee (WSMC) has developed over time, explored opportunities and constraints around freshwater availability and Rabi cropping, discussed the umbrella National Agriculture Policy (NAP) and its implications on the Khatail and Sekendarkhali communities, mapped capital assets and indicators, and lastly explored issues around market access and value chains.

3.5 Themes and focus questions for the prototype integrated models

At the SIAGI project team annual meeting in March 2018, a session was conducted where the team broke into sub-groups (this time by case study region) to brainstorm themes and key questions needing further investigation (with the integrated modelling if appropriate). The themes and questions are not yet fixed and are being revised and developed further by the SIAGI team.

The theme identified by the Dhaloguri/Uttar Chakowakheti group was *"Reaping the benefits from collectives"*. The intent of the theme is to understand how collectives build individual and group knowledge, develop connections with market and increase market return, and how (if) this leads to enhanced income. It considers both individual and the group dimensions, especially around decision-making, input sharing and the distribution of benefits. The theme is of broad relevance across all SIAGI case study area where the project team are working with community-based groups (including farmer groups or collectives, the WSMC, or Self-Help Groups).

Distinctions were made between the theme and associated questions for Khatail and Sekendarkhali in Bangladesh. In Sekendarkhali, the theme was *"Canal and community water use and management"* and considers issues of inclusion and equity around the management (of infrastructure and salinity intrusion) and distribution of freshwater in the Rabi season. In Khatail, the theme was *"Addressing the absence of agriculture-based livelihoods in the Rabi season"*. This is a broad issue, reflecting the many challenges facing the Khatail community including water and soil constraints, water use and management, institutional complexities, agricultural knowledge, markets and inputs, and natural calamity. The theme centres on understanding the constraints

and opportunities for both agricultural and local non-agricultural livelihoods, and how institutional capacity and transparency can be strengthened to enhance livelihoods.

"Catalysing and maintaining sustainable change" was the theme identified by the Bankura group. Centred around the motivations and mechanisms to trigger and sustain change, four scales at which introspection, learning and change occurred were identified: individuals (e.g. within a SHG), group (e.g. the SHG), individual practitioner (e.g. within an NGO or government agency) and organisation (e.g. the NGO or government agency). This theme is strongly aligned with impact pathways 3 and 4 in SIAGI's Theory of Change. Whilst it may not be focused upon as part of future integrated modelling activities, elements of the theme around individual and group decision-making have links to themes identified for Dhaloguri/Uttar Chakowakheti and Sekendarkhali, in particular.

Further detail on the questions and the development of prototype Fuzzy Cognitive Mapping (FCM) models based on the above themes is provided in Merritt and Hamilton, 2018. Integrated modelling efforts will continue to be concentrated on Dhaloguri/Uttar Chakowakheti, Khatail and Sekendarkhali villages.

4 Constraints and opportunities for beneficial engagement in agricultural intensification

Objective 1 in the SIAGI project proposal is to "understand the key social, institutional, economic and environmental factors affect livelihood risks, social exclusion, adverse incorporation and environmental degradation in agricultural intensification". This section synthesises the factors influencing households in the SIAGI case study villages in the context of agricultural intensification, drawing on documentation from the activities summarised in Section 3, and SIAGI reports for activities 1.1 to 1.6.

4.1 General factors influencing agricultural livelihoods and communities

As expected, recurrent constraints and opportunities of agricultural intensification exist across the SIAGI case studies. These are summarised in the schematic shown in

Figure 5, which highlights the diverse range of considerations that SIAGI takes into account. The broad constraints and opportunities relevant to all case studies are described below whilst country or case study specific cases are described in sections **Error! Reference source not found.** and 4.3. Given the great number of factors associated with agricultural livelihoods and communities, they were lumped into concepts in Figure 5 (and specified in **Error! Reference source not found.** and Table 3). For clarity, concepts are grouped into six broad themes: environmental, policy/institutional, market, social, agricultural production and (inter)household (the latter reflecting concepts present at the intra-household to village scale). This grouping is artificial and in reality there is a high degree of overlap and interaction between the variables within and across themes. The concepts in

Figure 5 are high-level and while useful for looking at broad connections they have limited used for examining specific issues, in which case the concepts need to broken down into finer detail.

Small and marginal farmers in our case study villages are commonly faced with difficulties in achieving adequate agricultural production to meet their various household needs, including income, nutrition, housing, education and health services, and comfort. Achieving sustainable agricultural intensification is often considered a central means of improving the social and economic conditions of these households. Agricultural intensification includes increasing land productivity, cropping intensity, resource use efficiency and/or crop diversity. Opportunities to achieving these may involve higher use of agricultural inputs, water resource development for irrigation, the adoption of technology or better practices (on-farm or post-harvest), and switching to higher value, higher yielding or drought-tolerant crop varieties. The challenge is in ensuring that small and marginalised farmers are neither excluded from nor disadvantaged by agricultural intensification. A wide range of, often interrelated, constraints at multiple levels (from individual, household, and community, through to state and national) need to be overcome for socially inclusive and sustainable intensification to occur in the communities.

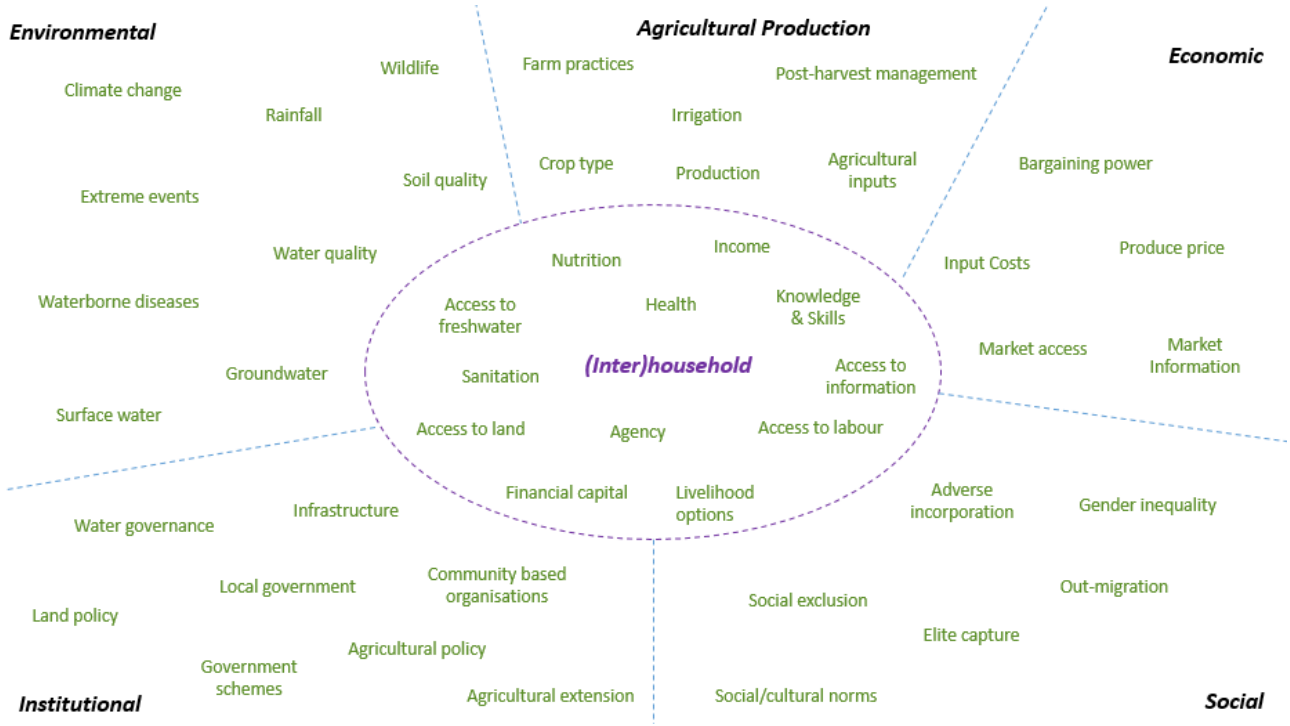

Figure 5 Synthesis of factors affecting agricultural livelihoods and common to the SIAGI case study villages.

The impact of increased climate variability on agricultural production is common across the case studies. The villages are susceptible to climate risks that affect access to water, including monsoon failure, weak monsoon or droughts, and extreme events such as hailstorms and cyclones. Climate change is expected to increase the likelihood and intensity these risks. Extreme events can cause direct damage to crops, and therefore loss of food or income, as well as damage to housing and other assets, hindering future farm investment. The environment context is intrinsically linked with both institutional water management and community irrigation management. In Khatail and Sekendarkhali, Bangladesh, institutional water management is posed in terms of salinity intrusion and thus freshwater availability in the Rabi Season. In Dhaloguri and Uttar Chakowakheti, groundwater levels largely determine freshwater availability in the Rabi season. With respect to community irrigation management, the access of marginal households to irrigation water in the Rabi season is a focus across all villages albeit with different drivers affecting how water is distributed and used by the communities. Irrigation has been one of the focal interventions by the two sister projects DSI4MTF and CSI4CZ. Not only does irrigation enable cultivation in the Rabi season, it can allow farmers to diversify their crops and adapt to the market and thereby achieve better returns. Improving linkages between farmers and the market is another key area of opportunity, investigated through the value chain analyses of the SIAGI and DSI4MTF projects.

Small and marginal farmers often receive low prices for their produce, especially at times of oversupply or when obliged into ‘distressed selling’ because of financial burden. This may be averted by farmers making crop choices based on market factors (i.e. selecting crops with higher returns), rather than making the choice based on existing practices. Therefore, access to market

information can be crucial for enabling farmers to get better gains. As one option, access to appropriate storage facilities can give farmers the ability to store their produce at times of oversupply (and thus low market price) and sell off-season when the price is higher. There are also opportunities for value adding post-harvest, for example, graded, sorted, cleaned or milled produce may fetch higher prices or open up new markets (e.g. graded produce can be sold to processing factories). SIAGI is working with farmers in the study villages to build their awareness of, and capacity to take up, the opportunities of value adding and market-oriented farming.

Low profitability for small and marginal farmers can also stem from the low production volumes against cost of production and trading. Farmers may get better prices when their produce is sold at the market, rather than at farm gate, however transport and other transaction costs make selling at market prohibitive for smaller farmers. Collectives and Farmer Producer Organisations (FPOs) provide small farmers the opportunity to improve their economies of scale in this regard. Aggregating under these groups may give farmers greater bargaining power to negotiate lower prices paid for inputs and transactions, and higher prices received for their produce. The latter can be associated with removing market entry barriers such as minimum supply volumes.

In addition to the amount of income from agriculture, the certainty of this income is also important. The certainty of income is affected by risks associated with production, including crop loss from extreme climate events or outbreaks of pests or disease, and general fluctuations in farm productivity and market prices of inputs and outputs. Certainty of income, together with the farmer's risk profile, can influence their capacity to plan and spend money on the farm as well as on their family (e.g. on their children's education).

The costs of agricultural technology and inputs can be a major barrier for many small and marginal farmers in achieving higher income. Without the financial capital to invest in the farm, they risk reinforcing the cycle of poor production and low income. Some opportunities exist in getting support from external agencies, with many public policies aimed at promoting agricultural intensification. However, in both India and Bangladesh, the institutional arrangements have weaknesses that result in inefficient and inequitable access to resources and services. The policy analyses of both countries identified the need for improved coordination between institutions to achieve effective policy implementation at a local level (refer to Reddy, 2017 and Jahan 2017).

Small and marginalised households often do not access government resources or services, partly due to lack of awareness of the schemes or limited capacities, for example they may be discouraged if a large amount of paperwork is required. On the other hand, government resources tend to be captured by those in the community that are well connected and resourced. This social exclusion of small and marginalised (including women-headed) households can hinder their ability to improve their livelihoods. Social exclusion in these communities stems from the social structure and cultural norms, which has led to a lack of agency in women and the marginalised. For example, in these communities, many women are reluctant to seek advice from extension officers even if they, theoretically, have access to them. Based on their experiences, SIAGI's NGO partners (PRADAN, CDHI and Shushilan) all have 'building of confidence in women and the marginalised poor' as one of the primary priorities in their community engagement work.

Another key social issue in these communities is out-migration, especially by young men. This is generally caused by lack of profitability in agriculture or lack of local work round the year, which

forces them to seek income elsewhere, often in nearby towns. With the male members absent, this places high work pressure on the women left to tend the farm and look after the family. At a village level, the seasonal migration also leads to labour shortage particularly during the Rabi season. Agriculture is a relatively low-value livelihood activity, and hard work, and in order to achieve agricultural intensification objectives of governments, agricultural intensification interventions may need to be conjointly developed with other local livelihood opportunities.

Table 2 Clustered factors affecting agricultural livelihoods of households in the SIAGI case study villages: household, agricultural production and social themes.

Theme	Concepts	Factors/risks include:
Household	Income	Income from agricultural and non-agricultural sources; amount of income/profit; income certainty
	Nutrition	Diet; food access; food security; malnutrition
	Health	Physical health; mental health
	Knowledge & skills	Formal education; knowledge of technology; skills
	Livelihood options	Non-agricultural livelihood options, including supplementary livelihoods (e.g. fishing, aquaculture, labour)
	Access to freshwater	Water for drinking, cooking, washing, agriculture and livestock
	Access to land	Tenure security; private acquisition of land; tenancy arrangements
	Sanitation	Toilet facilities; waste treatment; water treatment; hygiene
	Agency	Dignity; self-worth; confidence; self-determination; self-efficacy
	Financial capital	Access to credit; level of debt; savings; money available for investment; capacity to invest in farm and family
	Access to information	Awareness of schemes/policies/rights; information flow; Information on agricultural practices, technology
	Access to labour	Availability of farm labour (family labour and hired labour)
Agricultural production	Farm practices	Farming techniques; application of chemicals; cropping methods; weed/ pest management; integrated farming; furrowing, tillage, greenhouses etc
	Irrigation	Access to freshwater for irrigation; access to infrastructure; adequacy of irrigation infrastructure
	Agricultural inputs	Availability and access to agricultural inputs; fertilisers; pesticides; type and quality of seeds; machinery; energy/power for machinery and irrigation pumps (etc); adoption of agricultural technology
	Post-harvest management	Grading, sorting; access to storage facilities; value-adding; processing (cleaning, drying, milling, cooking); marketing
	Production	Quantity (volume) and quality of production; crop yields/farm productivity; timing of production and harvest; crop loss/damage
	Crop type	Crop choice; crop diversity
Social	Social exclusion	Exclusion from full participation in economic, social or political life in community; social discrimination based on caste, ethnicity, religion, gender, etc; restricted access to rights, resources, etc
	Adverse incorporation	Inclusion in economic, social or political life but on adverse terms due to inequalities in power; adverse inclusion in technology
	Gender inequality	Traditional gender roles; women's (limited) control/ decision making power; women's workload and pressure
	Elite capture	Wealth accumulation; power concentration; vested interests

	Out-migration	Seasonal migration; Forced migration due to lack of local work; depeasantisation
	Social/cultural norms	Patriarchal society; deep-rooted cultural prejudices and practices; social/cultural customs; social/community structure; social imbalance

Table 3 Clustered factors affecting agricultural livelihoods of households in the SIAGI case study villages: environmental, market and policy themes**.**

Theme	**Concepts**	**Factors/risks include:**
Environmental	Climate change	Climate variability; long-term climate change
	Extreme events	Cyclones; storm surges; hailstorms; floods; natural hazards
	Rainfall	Amount of rainfall; timing and intensity of rainfall events; frequency/duration of dry spells; monsoon (strength, timing)
	Soil quality	Soil salinity; soil acidity; soil fertility; waterlogging
	Surface water	Volume/flow of river/streams/canals; flow regulation
	Groundwater	Depth to groundwater; groundwater flow/pressure; groundwater depletion/overexploitation
	Wildlife	Biodiversity; ecology; interactions with wildlife, including conflict
	Water quality	Salinity; pollution, including pesticide contamination; turbidity, siltation
	Waterborne diseases	Presence of water-related diseases, e.g. cholera, malaria, typhoid, Hepatitis A, Giardia
Market	Market access	(Lack of) entry barriers including norms around market structure or around roles and mobility (e.g. of women); ability to consistently supply required volumes
	Bargaining power	Power to negotiate better prices (as both buyer and supplier)
	Input costs	Price of inputs (e.g. fertilisers, seeds, pesticides, transport); Price fluctuations
	Produce price	Price per unit of produce; Price fluctuations
	Market information	Market data on prices and other information about demand and supply
Policy	Infrastructure	Infrastructure for water, sanitation, health; Roads
	Water governance	Water policy governance comprehensiveness and design; groundwater policy; surface water policy; Policy awareness & compliance; subsidies (power, pump etc); community water management
	Land policy	Land use policy; Land rights & tenure policy; Impact of land reforms on agricultural livelihoods
	Agricultural extension	Investment in programs; number of extension officers; continuity of extension programs and duties; access to government support and extension, especially by marginal groups.
	Agricultural policy	Policies related to rural and agricultural development; Including policies related to inputs (irrigation, fertilizers, pesticides, machinery) and outputs (pricing, food, distribution, market, etc)
	Community-based organisations	Farmer producer organisations; farmer groups; self-help groups; water user associations; forest management committees
	Local government	Panchayati Raj Institutions or Gram (village) Panchayat in India, and Upazila Parishad in Bangladesh; policies related to drinking water supply, health, sanitation, education, roads, bridges and other amenities

	Government schemes (India)	Mahatma Gandhi National Rural Employment Guarantee Scheme; Public Distribution System

For many of the small-holder and marginalised farmers, their land is their primary source of food. One key concern has been not so much the scarcity of food, but the deficiency of nutrition. Nutrition-blind development has been recognised as one of the critical risks to health outcomes in the communities. Much development research and programming currently reflects a general lack of awareness (across the range of local, national, global stakeholders) of the links between agricultural development and nutrition outcomes (and more broadly with ecology and society, sanitation and health, and well-being). Nutrition Sensitive Agriculture (NSA) is an area of emergent research that is the focus of the Australia Awards fellowship with PRADAN and CSIRO. Given the interwoven nature of issues related to social inclusion and agricultural intensification, it is crucial that interventions and policies are not too narrowly focussed and are attentive to the context of the people they intend to help.

4.2 Factors relevant to Khatail and Sekendarkhali, Bangladesh

For Khatail (

Table 4) and Sekendarkhali (Table 5

From a policy perspective, in both Khatail and Sekendarkhali, lack of access to freshwater is considered the primary concern. The policy gaps that currently exist stem from both the design of water policies (e.g. the lack of cross-sectoral guidelines for multiple water uses in rural areas) and the lack of co-ordination between policy makers and implementers (e.g. limited governance around the management of polders and operation of sluice gates) (Jahan 2017). Whether or not the elite are inclined, empowered or allowed to capture water infrastructure (and use it at the detriment of others) relates to the social structure of the community and the influence of local bodies such as the Union Parishad. There are also some issues with respect to the implementation of the National Agriculture Policy. The communities' needs for extension and management support relate to mechanization, context specific information, interdepartmental coordination for specific issues (e.g. where), and support for collectives/cooperatives (Merritt et al. 2018). In some cases these needs are being met – for example interdepartmental coordination when the WSMC sought the required approval from fishery and other departments for the Hafamari canal excavation. More problematic is the access to government support and extension by poorer farmers, with much of the focus from government officers being on richer farmers. This is in part due to the (perhaps subconscious) assumption that the poor will not or cannot adopt new crops or technologies.

Social barriers including conflict of interest, societal-level gender issues and social customs impact community allocation of available resources (water or land) or uptake of services by individuals. The SIAGI project team is investing heavily in working with the community to address some of the aforementioned constraints limiting poorer households from engaging beneficially in agricultural intensification.

There is potential for SIAGI to investigate the extent of (and act upon) any interest for collectives focused on agricultural production and marketing in both villages. In Sekendarkhali, this may be a way to increase production and bargaining power for the marketing of crops like cauliflower, cabbage and leafy vegetables. In Khatail, assuming soil and water constraints can be managed, there may be opportunities to increase production volumes of crops. In the past there was a cooperative view in Khatail for fisheries and other actions but not for crop production. This is starting to change and more knowledgeable farmers are now sharing market information with other farmers and there is more targeted crop choices. Other opportunities to improve market-oriented agricultural productions, and the income gained from this, are listed in Table 6.

Table 5), there are several key constraints to community water management, social inclusion and agricultural production in the Rabi season. Some of these have been fully or partially alleviated since the inception of the ACIAR sister projects. Others will not be easy to overcome. For Khatail, in particular, the SIAGI team has acknowledged that the severe biophysical constraints may mean that environmentally sustainable and financially viable crop-based livelihoods are unattainable and the team needs to explore other local livelihood activities (e.g. aquaculture) to complement agricultural activities. For this reason, Shushilan are working with farmer groups in Khatail to develop integrated farming[3].

The environmental and climatic factors that constrain agricultural production in the Rabi season are common to both Khatail and Sekendarkhali. However, Khatail is more severely impacted by both soil salinity and salinity in the rivers and canals. Soil salinity is a major constraint and there are limits to the extent it can be mitigated into the future. This is particularly in the longer term given with expected sea level rises and worsening river salinity. That said, the farmer groups established by Shushilan have constructed three dykes in Khatail which (at least in the short term) should reduce the ingress of saline water and allow the storage of freshwater for irrigation and management of soil salinity. Appropriate management of salinity intrusion is still needed in Sekendarkhali, despite the greater potential for supply of fresh water for irrigation via the nearby Payra River.

Cyclones and accompanying storm surges have had serious impacts on the two communities including: waterlogging due to overtopping or breaching of embankments; physical damage and contamination of sources of drinking water (e.g. ponds, canals, rainwater tanks); flood damage to crops and aquaculture; and increased soil salinity. These impacts have been exacerbated by the poor management and maintenance of infrastructure (e.g. embankments). For example, the poor maintenance of the sluice gates, can delay the removal of excess water in the rainy season, exacerbating waterlogging and drainage issues. There are also problems with management of the infrastructure with influential individuals using the gates and drainage channels in an unauthorised way, for their own benefit (e.g. shrimp farming in Khatail).

For the SIAGI target beneficiaries to be able to engage more effectively with markets, the desired characteristics of farmers are that they: are capable in growing good quality product and properly grading the produce; have a range of production options; and have bargaining power whereby they have some say in setting the price for their produce. The current situation in Khatail is that the market is 'ready' but it is not matched by production in the Rabi season. It is not certain if there are inclusion or equity issues in the Rabi season given such low levels of production. However, there are such issues in the Aman season where, at the time of harvesting, small farmers get low prices as they need cash quickly ('distressed sellers') and do not have access to storage facilities. Additionally, there is scarcity of labour (as men migrate pre-harvest) which can lead to production losses and delays to any planned Rabi cropping. The current situation in Sekendarkhali is much more positive. Both local and external markets are ready and the farmers are able to supply surplus production of Rabi crop such as chilli, sweet potato, and groundnut to the district

[3] See https://siagi.org/2018/03/13/yes-we-can-women-managed-integrated-farming-systems/, accessed 06/06/2018

level markets. Companies exist that can provide hybrid seed to farmers; this is a big contrast with Khatail. Sekendarkhali is closely connected to the two big markets, therefore farmers can get reasonably high prices for their produce.

Table 4 Key constraints to socially inclusive agricultural intensification in the Rabi season in Khatail.

Theme	Constraints
Agricultural production	• Absence of companies that can provide hybrid seed to farmers • Typically seed for pulses, beans, vegetable, etc are hard to source because there is no national government provider promoting such crops and there is limited local experience in cultivating these crops (and therefore very limited seed saving) • Mechanization is too expensive for poor individuals to invest in by themselves • Power and irrigation assets too expensive for poor individuals to invest in despite ~30-40% subsidy
Environment and climate	• Salinity of soils and water • Water shortages • Storm surges and cyclones • Waterlogging
Market	• Small volumes of poor quality crops are grown in the village due mostly to biophysical constraints (soil and salinity) • Short value chain with local sales of limited quantities produce that are not value-added • Level of market knowledge (e.g. price of input and product, quality of seeds) of many farmers is low
Policy & Institutional	• Government agriculture officers are present but much of their focus is on the 'richer' farmers especially around new crops and technologies • Dysfunctional water management associations and groups • The Department of Agricultural Marketing is either not present or not effective at the Upazila level • Not all farmers have access to the manual containing crop-specific agronomic advice • For local training, policy dictates that women participation should be 33% but in reality women often sign the attendance sheet and then don't attend.
Social	• Free-roaming livestock in the Rabi *(community controlled and no longer a constraint)* • Taking a gender lens to extension and management, poor women theoretically have access to agriculture officers but do not seek them out. They lack confidence and are reluctant to speak, indicating a real need to continue building social capital. • Women's non-attendance at local training means is a reliance on knowledge transfer from participating husbands which is not sustainable for training in dry season agriculture if the husband is seasonally migrating • 70-80% of loans provided to women by NGOs for women get handed over to men; the women are responsible for repaying the loan but have no control over the money

From a policy perspective, in both Khatail and Sekendarkhali, lack of access to freshwater is considered the primary concern. The policy gaps that currently exist stem from both the design of water policies (e.g. the lack of cross-sectoral guidelines for multiple water uses in rural areas) and the lack of co-ordination between policy makers and implementers (e.g. limited governance around the management of polders and operation of sluice gates) (Jahan 2017). Whether or not the elite are inclined, empowered or allowed to capture water infrastructure (and use it at the detriment of others) relates to the social structure of the community and the influence of local bodies such as the Union Parishad. There are also some issues with respect to the implementation of the National Agriculture Policy. The communities' needs for extension and management support relate to mechanization, context specific information, interdepartmental coordination for

specific issues (e.g. where), and support for collectives/cooperatives (Merritt et al. 2018). In some cases these needs are being met – for example interdepartmental coordination when the WSMC sought the required approval from fishery and other departments for the Hafamari canal excavation. More problematic is the access to government support and extension by poorer farmers, with much of the focus from government officers being on richer farmers. This is in part due to the (perhaps subconscious) assumption that the poor will not or cannot adopt new crops or technologies.

Social barriers including conflict of interest, societal-level gender issues and social customs impact community allocation of available resources (water or land) or uptake of services by individuals. The SIAGI project team is investing heavily in working with the community to address some of the aforementioned constraints limiting poorer households from engaging beneficially in agricultural intensification.

There is potential for SIAGI to investigate the extent of (and act upon) any interest for collectives focused on agricultural production and marketing in both villages. In Sekendarkhali, this may be a way to increase production and bargaining power for the marketing of crops like cauliflower, cabbage and leafy vegetables. In Khatail, assuming soil and water constraints can be managed, there may be opportunities to increase production volumes of crops. In the past there was a cooperative view in Khatail for fisheries and other actions but not for crop production. This is starting to change and more knowledgeable farmers are now sharing market information with other farmers and there is more targeted crop choices. Other opportunities to improve market-oriented agricultural productions, and the income gained from this, are listed in Table 6.

Table 5 Key constraints to socially inclusive agricultural intensification in the Rabi season in Sekendarkhali.

Theme	Constraints
Agricultural production (inputs)	• Land access due to tenure arrangement *(expected to improve)* • Insufficient irrigation infrastructure *(more so for women as their land is often farther from the canal than other farmers)* • Typically seed for pulses, beans, vegetable, etc are hard to source because there is no national government provider promoting such crops and there is limited local experience in cultivating these crops (and therefore very limited seed saving) • Credit is available but can be complex to access; government credit schemes target the landed, that is those farmers who have legal ownership of their land
Environment and climate	• Salinity of soils and water *(not as severe as in Khatail)* • Water shortages • Storm surges and cyclones • Waterlogging • Early rainfall
Market	• Production not maximised due to salinity issues • The Department of Agricultural Marketing is either not present or not effective at the Upazila level
Policy & Institutional	• Growth Centres market committee provide advice and financial and technical support to farmers but this advice and support is not equitably accessed; only those who own land access this resource • Institutional arrangements *(expected that future needs will be met by sustainable WSMC)* • Not all farmers have access to the manual containing crop-specific agronomic advice • For local training, policy dictates that women participation should be 33% but in reality women often sign the attendance sheet and then don't attend.
Social	• Influence of the politically connected on community control over water *(community water management to continually strengthening as the WSMC is becoming become more capable and mature)* • Lack of collective initiative/decisions around the choice of crops and distribution of water *(expected to improve)* • Taking a gender lens to extension and management, poor women theoretically have access to agriculture officers but do not seek them out. They lack confidence and are reluctant to speak, indicating a real need to continue building social capital. • Women's non-attendance at local training means is a reliance on knowledge transfer from participating husbands which is not sustainable for training in dry season agriculture if the husband is seasonally migrating • 70-80% of loans provided to women by NGOs for women get handed over to men; the women are responsible for repaying the loan but have no control over the money

In both Khatail and Sekendarkhali, addressing environmental and climate constraints might be through better management, access to and maintenance of irrigation facilities or through improved farming practices, including the cultivation of more diverse and suitable crop varieties. Prior to the establishment of the WSMC in Sekendarkhali, the canals (and therefore water) were 'public owned but not public controlled'. There was unequal capacity for farmers to access water with distance and lack of irrigation equipment being major constraints. The situation is improving but some concerns remain, including improvement for women being conditional on getting access to pumps. Leaders are developing naturally within the members of the farmer groups which is more critical in Khatail (compared to Sekendarkhali) where the Union Parishad chairman is not supportive of poor farmers with respect to controlling sluice gates and the ingress of saline river water in the dry season. The groups in Khatail are sharing knowledge and starting to delegate roles

and responsibilities within team (e.g. some have taken on technical role of germinating seed and distributing seedlings to others).

Table 6 Opportunities to improve market-oriented crop production.

Khatail	Sekendarkhali

• Training to develop production and grading skills
• Identification of multiple value chains
• Strategies to increase price received by farmers, e.g.
  ○ cold storage facilities
  ○ interventions to strengthen the institutional capacity of growth centres
  ○ efforts to build bargaining power and market knowledge
  ○ move to demand-based production (maximize returns)
  ○ investigation of value-adding crops (this may be limited)
• Creation of opportunities to access external markets (this would require a certain volume of production and sufficient transport)
	• Provide training opportunities for those currently excluded from growth centre activities and technical support (e.g. farm equipment).
	• Chilli lends itself to value-adding
	• Good prospects for interventions with respect to sunflower because of the existence of cooperative mill
	• Opportunities may also exist for involvement of private companies (e.g. building on local mill for sunflower

4.3 Factors relevant to Dhaloguri and Uttar Chakowakheti, West Bengal

A summary of the constraints to dry season agricultural production in Dhaloguri and Uttar Chakowakheti is provided in Table 7. Of the two Indian villages, Uttar Chakowakheti is exposed to a greater range of environmental risks to agricultural livelihoods and human health and well-being. In part this is due to its close proximity to the forest and the major Kaljani River, which also provide benefits of forest-based livelihood and sand mining opportunities for villagers. The greater distance to market from Uttar Chakowakheti, and reliance upon bicycles, makes market access challenging particularly for women. Specific to Uttar Chakowakheti is the risk of production losses due to elephant feeding on crops; by extension this has implications on the types of crops that farmers can grow which will not be eaten and whether these are in market demand. Crops like mustard, hybrid maize, elephant foot yam, lemon and chilli are not palatable to elephants and are also high return crops with some value-adding potential. DSI4MTF and CDHI have been working with collectives and the broader community to trial such crops.

Increases in crop intensity and yields have been reported in Dhaloguri over recent years as a result of interventions carried out in the DSI4MTF project, including installation of irrigation facilities, and increased crop diversification. The activities of the collectives, with support from the DSI4MTF project team has demonstrated that there are opportunities to improve crop yields and intensify agricultural production in the two villages through better access to irrigation facilities, uptake of market-oriented crops and improved varieties (e.g. early harvesting varieties of paddy), off-season vegetable production in greenhouses, and better farming practices.

With respect to groundwater use and management in West Bengal, extraction of shallow groundwater without permission is prohibited. Although these rules are strictly adhered to in South Bengal, it is less so in North Bengal where current groundwater use is not yet extensive and rainfall is high (3200-3600 mm/year), such that groundwater levels are replenished during the

monsoon season. Although current groundwater extraction levels are not of concern, CDHI is building awareness within the community about managing resources for the next generation, including the need to avoid contamination of groundwater, maintain sanitation distance from tube wells, and understanding how the distance between wells affects depression zones. This awareness building is intended to help avoid future potential risk of groundwater depletion. With the infrastructure and monitoring from the DSI4MTF project, the community are able to observe how depletion occurs due to pumping and how long levels take to recover. Another constraint related to irrigation technology, is the maintenance and repair of the infrastructure; with no 'fitter' to fix pumps in the village, it can take a long time to get a mechanic to fix the equipment. Given the lack of service providers, some farmers are trying to learn to fix their equipment which may potentially open up livelihood activities for them.

Table 7 Key constraints to socially inclusive and sustainable agricultural production in Dhaloguri and Uttar Chakowakheti.

Theme	Constraints
Agricultural production	• Relatively undeveloped groundwater resources *(This is changing)* • Lack of nearby service providers to maintain and repair irrigation infrastructure • Open grazing resulting in reduction of crop production of maize and mustard • *Uttar Chakowakheti:* Poor access to irrigation infrastructure *(This is changing)* • *Uttar Chakowakheti:* Elephants eating crops • *Uttar Chakowakheti:* Limited farming knowledge (akin to first generation farmers)
Environment	• Less reliable rainfall, including late monsoons, droughts and at other times excess rains • Many soils with low water holding capacity and poor in available nutrients • Contamination of rivers with chemical fertilisers and pesticides • Hailstorms (higher risk of damage in summer) • *Uttar Chakowakheti:* River flooding • *Uttar Chakowakheti:* sand mining
Market	• Overcoming the social norms of women not being involved in the market; going to the market is physically difficult and time-consuming as bicycles are the means of transport; most women have little bargaining power *(This is changing)* • Limited consideration of market demand for crops *(This is changing)* • Lack of low-cost storage facilities or options to preserve produce
Policy/ Institutions	• West Bengal land reforms has had negative implications for agricultural viability and household income due to small size of holdings • Lack of explicit policy support for strengthening tenancy arrangements (e.g. tenants not eligible for bank loans or input subsidies) • Lack of policy strategies focusing on improving viability of agriculture • Lack of incentives, promotional policies, markets and institutions for sustainable agriculture • Limited state support and initiative for intensification/diversification • State is slow in market reforms. Recently good market infrastructure was developed by the government, but they remain mostly underutilised • Low numbers of on-ground staff means service delivery relies on a central delivery point and raises potential that resources may not be equitably or transparently distributed • Process of completing and submitting applications, including literacy requirements and access to internet • Awareness of schemes is often a major gap preventing the community accessing opportunities or entitlements • Sheer number of schemes available from different departments and the different rules and requirements that these schemes have
Social	• State and community level politics can affect how benefits from a scheme are distributed • Relationship between service providers (including government agencies) and the community seemingly lacking in empathy, respect and trust

	• Elite capture of government resources and services

CDHI have also facilitated discussions about the water use efficiencies of crops. For the amount of water required to irrigate paddy, for example, there is not much return compared with potato where furrow practices can help reduce irrigation volumes and save money. CDHI is helping the farming community to cultivate less water consuming (and high return) crops like mustard, maize, spinach, capsicum etc. As these crops require less water they can result in increased profits. If they are grown in low-cost greenhouses, they can also achieve off-season premiums.

The soils in both Indian villages are slightly acidic and of low fertility, and require appropriate fertilizer and other agronomy practices to achieve good agricultural yields. In Uttar Chakowakheti there are eight STWs installed by the government, but groundwater discharge is reportedly low due to the multilayered aquifer system (Bastakoti 2017). Other problems with groundwater resources reported in Uttar Chakowakheti include unreliable access to electricity for groundwater pumping, and although groundwater can be pumped in early winter, the water table rapidly declines. Dhaloguri has better access to groundwater, particularly from interventions through the DSI4MTF project, and as result has a substantially higher cropping intensity, with 55% land cultivated in 2015/2016 Rabi compared to 9% in Uttar Chakowakheti (Sugden et al. 2016).

Farmers in both Indian villages have expressed concern about climate variability, in particular the decreasing amount and reliability of rainfall and more frequent occurrence of extreme events (flooding, droughts, hailstorms). These changes can have significant implications on farming, especially rainfed crops. Hailstorms typically occur between mid-April to end of May, and can cause serious damage to crops; farmers need to consider this risk if cultivating in summer. Some risks may not be controllable but DSI4MTF and SIAGI through CDHI are trying to empower the community to respond to adversity by increasing flexibility around crop choice or livelihoods.

One of the key opportunities for farmers to improve their agricultural income is through better linkages with the market. Farmers in the villages typically do not consider market demand when selecting crops to cultivate, however this now starting to change, at least within the collectives. During a recent informal discussion with farmers, some farmers realized that they were, unknowingly, starting to think in terms of market demand for some crops such as garlic, cauliflower, spinach, broccoli and capsicum. With a price of 50 Rs/kg for off-season spinach last Rabi (compared to the normal price of 10 Rs/kg in-season), traders were ringing farmers to see where their crops were at and trying to guarantee purchase. Technical options to preserve vegetables and potato could help farmers gain bargaining power and better prices. Although it is difficult to access cold storage, some low cost technologies are being adopted by farmers (e.g. storing potatoes in sand). CDHI and the farmers are analysing recent years of production and profit, and when needed CDHI are organising training with relevant experts. In addition to the need for farmers to understand and take advantage of market forces, institutional improvements are needed to support farmers.

Although most of the required government institutions exist, the problem lies in their low capacities, including insufficient numbers of on-ground staff. Each agricultural extension worker is responsible for an area so large they often require a central delivery point. For example an extension worker may use one contact farmer to distribute seed to the community, however such

farmers may not distribute it equitably amongst community members. As well as a lack of field presence, many government schemes either remain unknown to those who would benefit most from them or are exploited by those in the know. Access to schemes can also be constrained by the application process, which may require literacy or access to the internet. Or in the case of many soil and water conservation interventions, small and marginal farmers do not meet the minimum requirements as their plots are too small.

Institutions need to be strengthened and the community empowered to see that benefits are allocated on a needs basis, rather than focused on those with more power or resources. To be effective, government and service providers need to understand the local context. For example, for meeting environmental objectives, the government need to be cognizant that the primary issues faced by the local community are health and livelihoods. Without a livelihood component, environmental (and other) programs will not gain traction with the community. Similarly, attempts to stop sand mining in Uttar Chakowakheti have been unsuccessful. Despite potential negative impacts of the mining on rivers and drinking water wells on the embankments of the rivers, this is a challenging issue as it remains an important source of livelihood for many villagers. It seems sand mining will remain within the community, at least until better livelihood options become available. Regarding government schemes, CDHI is working with the community so that they can stand up for themselves and gain equity in accessing government resources. The steps are: 1) facilitate the process of community engagement, 2) impart knowledge about the process and their basic rights, 3) increase bargaining power by facilitating and building confidence, 4) encourage involvement and monitoring, and 5) co-create options (e.g. different strategies to avoid middle men or bargain for better outcomes).

Table 8 Opportunities provided by collectives to socially inclusive and sustainable agricultural production in Dhaloguri and Uttar Chakowakheti.

West Bengal
• Awareness of and access to government schemes • Better access to machinery, tools and other technology • Shared learning about new agricultural practices and technology, crop types and varieties, market and value chain – through training, demonstration plots and field trials, group meetings and discussions, etc • Working at larger scales can provide farmers with greater bargaining power and better market access – this may reduce cost of production and improve price received for produce • Farmers will share risks associated with agricultural production and markets, and address failures or sub-optimal outcomes together • Through working together, improved social bonding and respect for landless among the collective • Empower small and marginal producers, including women. When members have power over the decision-making process and recognise their knowledge about farming, their sense of agency and self-worth improves. • As a group, they may be more confident to stand up for themselves, including challenging the government

Community based organisations (CBOs) such as collectives and self-help groups can play a critical role in implementing policies efficiently and equitably, as well as disseminating awareness about available schemes. Collectives provide many other opportunities and benefits to farmers via multiple impact pathways (Table 8). As collectives, farmers can pool resources and face challenges involved with agricultural cultivation and market access together, including sharing information, trialling new crops or technologies (e.g. greenhouse), and developing links with institutional actors. Some of the costs of technology are prohibitively high for poor individuals, but potentially

within the realm of collectives including through joint applications for funds (e.g. for irrigation infrastructure). There are several potential challenges of collectives such as issues with profit sharing, sharing contribution (whether it be in the form of land, monetary contributions or labour), and decision making. However if organised in a manner deemed fair by all members, collectives have great potential to achieve the benefits described above, as well as building confidence and a sense of agency in its members. An improved sense of agency can help overcome barriers to improving livelihoods. For example, some women from Uttar Chakowakheti have started going to the market to sell their products, after interventions from the DSI4MTF and SIAGI projects.

5 Conclusion

Project activities 1.1 to 1.8 have highlighted the manifold and complex challenges involved in achieving socially inclusive and sustainable agricultural intensification. Evidence from the literature, past experience of our project partners, and learnings from our community engagement has shown that myopic attempts to address problems are susceptible to failure (at least in the long term) and can potentially introduce new problems (for the target beneficiaries or other people in their community or surrounding locales). An integrative perspective is crucial for achieving long-term, positive outcomes for marginalised households. This involves assessing opportunities in conjunction with other risks and opportunities and in light of the contextual setting (including cultural, social, health and economic characteristics) of household members. Also, it is imperative to appreciate that individuals have different goals and values beyond income, and that achievements such as improved knowledge, better social relations and sense of agency are not only positive outcomes in themselves but vital means to achieving further outcomes. In terms of the integrated modelling and broader SIAGI research, these findings confirm the importance of community engagement to ensure the contextual factors and values held by community members are sufficiently understood. Also, the multifactorial and interwoven nature of issues necessitates that linkages between other factors are continuously considered.

A demonstration of how the synthesis described in this report is helping the SIAGI project team refine our research activities for the remainder of the project is given in

Figure 6. As mentioned earlier, the intent of the theme *"Reaping the benefits from collectives"* is to understand how collectives build individual and group knowledge, develop connections with market and increase market return, and how (if) this leads to enhanced income. Ultimately, we want within SIAGI to shift from the market focus of collectivization (the shaded area depicted in the figure) and explore how to set up or manage collectives so that they 'creep' towards other areas where we can affect positive change (Lim-Camacho *pers. comm*., 06/06/2018). Thinking around collectives in SIAGI might thus broaden to include nutrition-sensitive agriculture interventions, benefits in terms of agency, and gender issues (

Figure 6). For example, this could be addressing gender inequality by developing support mechanisms to market as a group so that women can enter markets, or by creating or enhancing livelihood options (e.g. start processing by-products to add value, as opposed to becoming waste).

Similarly, we could map out the focus for the themes identified for Khatail and Sekendarkhali. By focusing on a case study, and defining the boundary of the problem we can move beyond the high level concepts as they are described in Section 4.1 to a finer granularity. Having identified Fuzzy Cognitive Maps as an appropriate tool to use in Objective 2 activities, we are working to develop prototype models based on the themes identified for the case studies. Progress on this is documented in the companion report by Merritt and Hamilton, 2018.

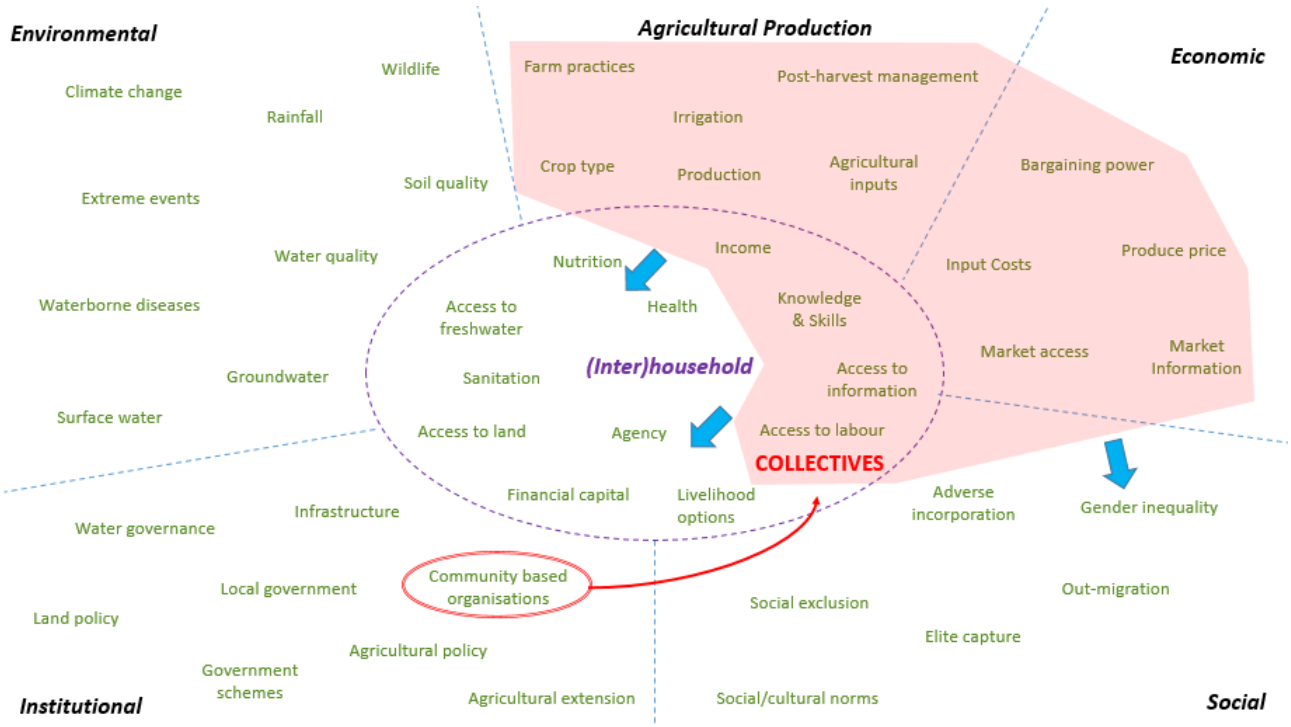

Figure 6 Scoping the problem boundary for "Reaping the benefits from collectives".

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