Promoting climate resilient agriculture

A VALUE CHAIN APPROACH

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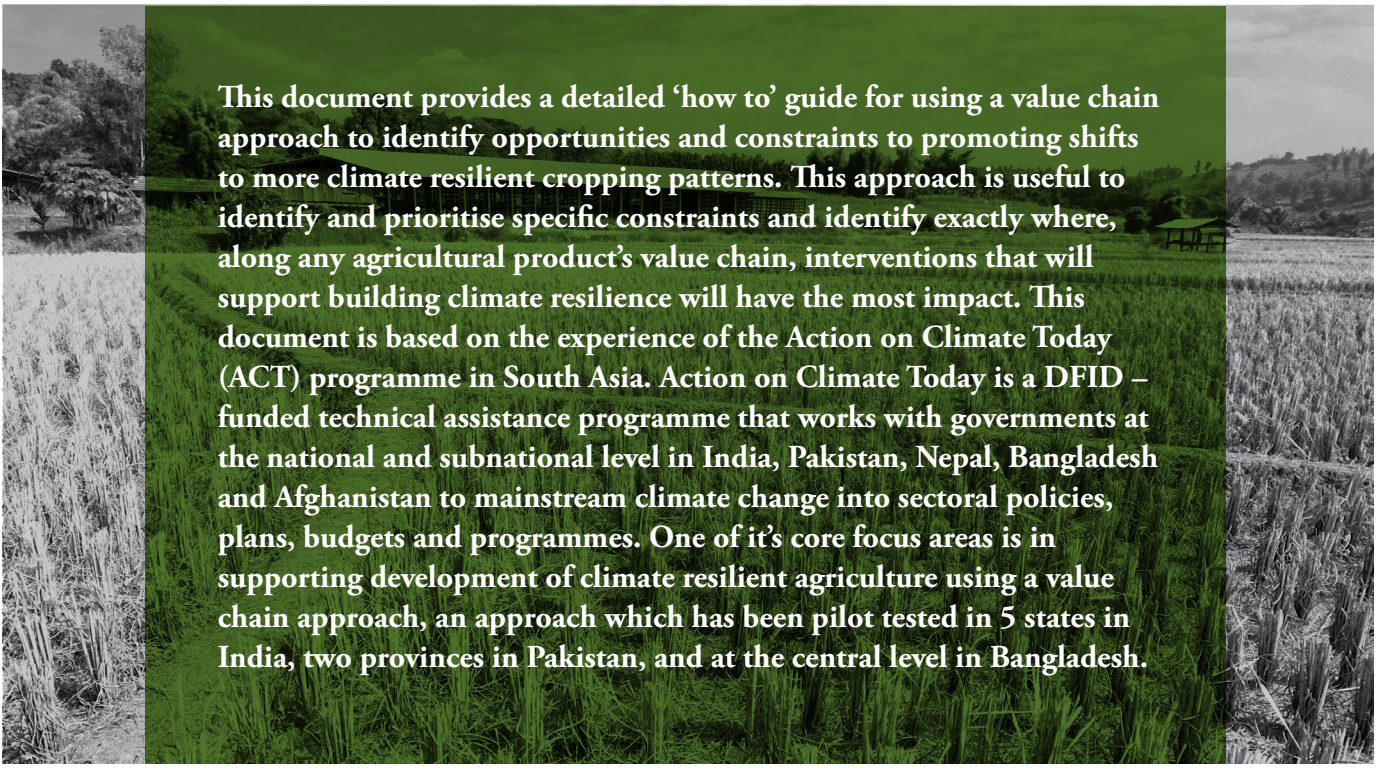
ACRONYMS

ACT	Action on Climate Today
BVZ	Barak Valley Zone
CBVZ	Central Brahmaputra Valley Zone
CDB	Cotton Development Board
CRA	Climate Resilient Agriculture
DFID	Department for International Development
FPC	Farmer Producer Company
HZ	Hill Zone
ICCCAD	International Centre for Climate Change and Development
KGF	Krishi Gobeshona Foundation
LBVZ	Lower Brahmaputra Valley Zone
MCA	Multi-Criteria Analysis
NATA	National Agricultural Training Academy
NBPZ	North Bank Plain Zone
PoCRA	Project on Climate Resilient Agriculture
UBVZ	Upper Brahmaputra Valley Zone
VCA	Value Chain Analysis

BACKGROUND



This document provides a detailed 'how to' guide for using a value chain approach to identify opportunities and constraints to promoting shifts to more climate resilient cropping patterns. This approach is useful to identify and prioritise specific constraints and identify exactly where, along any agricultural product's value chain, interventions that will support building climate resilience will have the most impact. This document is based on the experience of the Action on Climate Today (ACT) programme in South Asia. Action on Climate Today is a DFID – funded technical assistance programme that works with governments at the national and subnational level in India, Pakistan, Nepal, Bangladesh and Afghanistan to mainstream climate change into sectoral policies, plans, budgets and programmes. One of it's core focus areas is in supporting development of climate resilient agriculture using a value chain approach, an approach which has been pilot tested in 5 states in India, two provinces in Pakistan, and at the central level in Bangladesh.

Why use a Value chain approach?

Farming has always been dependent on whims of the weather. For tens of thousands of years, farmers have developed multiple skills to manage the various risks that accompany changes in weather patterns. These can be the extremes of droughts or floods or less dramatic but still potentially damaging shifts in the weather. such as erratic rainfall, strong winds, heatwaves, long gaps in between showers, the late onset of the rainy season, pest or disease infestations and so on.

Climate change adds to the weather-risks farmers face. New weather patterns can emerge over relatively short periods of time and extreme events such as droughts, floods and heatwaves are projected to occur more frequently, there may be shifts in rainy seasons and their durations may change.

In south Asia, shifts in the monsoon timing has impacts on both yields and crop choices. A late start to the monsoon can reduce yields of ***kharif*** (summer) crops dramatically. Delays in monsoons can lead to delays in planting rabi (winter) crops, which in turn can reduce yields and increase the risk of disease. In most cases, responding to changes in weather patterns requires adjustment to cropping patterns to build more resilience into the farming system. But to do this effectively requires shifts in the composition of cropping patterns to include more climate resilient crops and/or varieties.

Building farming systems' resilience to the impacts of climate means that they have to be adapted to new rainfall or temperature regimes, as well as survive recurrent extreme events. Historically most farmers and farming communities would experience extreme events such as floods, droughts and long, hot, dry spells interspersed with periods of 'normal' weather. Climate change brings with it new weather patterns where these extreme events occur more frequently. Droughts that last more than one or two years, or recurring heavy flooding magnify existing vulnerabilities in farming systems. All farmers are affected, and resource-poor farmers, whose livelihoods are often already vulnerable because of issues such as degraded soils, small

and fragmented holdings, distance from markets and inadequate farm technologies can be pushed into a downward spiral of insecurity that, in the worst cases, can lead to destitution.

Adapting to shifts in weather patterns will often require fundamental changes in cropping patterns. In this context, diversification becomes an important risk mitigation tactic for farmers. Shifting cultivation patterns and practices in response to changing weather conditions is something farmers have always done. Diversifying cropping patterns is part of this strategy. When farmers make such changes in response to climate change it is sometimes referred to as 'autonomous adaptation'.

However, these shifts may not, on their own, be sufficient to mitigate the challenges that major changes in weather patterns pose. A key question will remain, if diversification might provide a viable adaptation tactic, what should farmers diversify into? Farmers, especially poorer ones, may not have access to useful information on which crops have suitable characteristics to thrive in the changed climatic conditions. Even if they know of likely climate resilient crops, they may not feel confident they have the knowledge and experience to cultivate them successfully, or whether suitable markets exist. With limited resources, changing to the unknown presents a major risk. There is a role here for government agricultural policies and services, along with other providers of agricultural advice, to support farmers in this transition.

This paper describes an approach that can be used to identify opportunities and constraints along the value chains of individual crops and/ or varieties. This approach provides a generic methodology that can be used to understand constraints and opportunities in developing markets for any crop. It can be used for multiple reasons, ranging from studying an individual crop to looking at whole farming systems.

It is important to note that although this approach follows the whole value chain, it is slightly different from the conventional application of 'value chain analysis' as an economic tool, which sets out to identify how value is added at each stage along a commodity's value chain. Instead, **ACT has used this approach to explicitly explore the constraints and opportunities of developing more climate resilient cropping patterns.**

BOX 1

IDENTIFYING CLIMATE RESILIENT CROPPING PATTERNS: A VALUE CHAIN APPROACH ADDS VALUE

ACT started using a value chain approach to assist Agriculture departments / ministries identify and support viable changes to cropping systems in response to climate change. Senior staff often proposed crop diversification, as this is a longstanding way to mitigate weather-related risks. Growing a range crops spreads that risk. One crop may still suffer from a change in the weather, but the other crops may not suffer so much, or at all.

However, Agricultural Departments, and the extension service in particular, tend to focus on providing support to what happens on the farm – providing advice and support for 'production'. However, on-farm production alone is only part of any agricultural product's journey from seed to final consumption and use. The simple fact that a particular crop may have characteristics that will suit new weather patterns, does not necessarily mean that it makes financial sense to grow it. In addition, many of the constraints to profitability may have nothing to do with what happens on farm but are instead due to bottlenecks elsewhere along a product's value chain. Even farmers' own understanding of whether a crop can be profitable may be limited by a lack of market information, or poor terms of trade between farmers and intermediary traders.

Some constraints may not be directly related to climatic factors, but building climate resilience depends of addressing them.

By analysing the full value chain of potentially climate resilient crops, it becomes possible to understand where both the major barriers and opportunities to increasing their cultivation actually lie: is it on farm? … or is it elsewhere?

Using a value chain approach in this way is not an end in itself. It is simply a tool to build a robust understanding of further interventions and support that will increase the climate resilience of any agricultural production system.

This approach has been used by the ACT programme to support departments / ministries of agriculture specifically identify and understand constraints and opportunities along the value chain of certain crops that have been identified as having a level of climate resilience. These are crops that are being grown already, but where there is scope to increase their cropped area in order to increase the overall resilience of local farm systems. For example, in areas where droughts and hot dry spells are becoming more frequent, the aim is to look at opportunities to reduce the area under water-hungry crops and expand the area under crops that require less water.

The major advantage of using a value chain approach is that it forces analysis and planning to consider the whole value chain – not just a part of it. Initiatives that focus on building climate resilience in farming systems and supporting adaptation often focus solely on what is happening on the farm – and particularly on technology options that aim to improve land husbandry practices. Of course, this is a very important area of focus. Cultivation techniques, irrigation, and soil and water conservation are all important factors to consider when looking at how to best adapt to changes in weather patterns.

But what happens on the farm is not the whole story. Climate change can have impacts along the whole value chain (see **Figure 1,** below) and the most constraining bottlenecks along the chain may not be the farm production process itself.

BOX 2

UNDERSTANDING HOW A VALUE CHAIN APPROACH ADDS VALUE

In early discussions, Agricultural department staff frequently asked how this methodology adds value. They felt they already knew which crops have specific characteristics that address new climatic conditions such as more frequent droughts, heat stress or flooding.

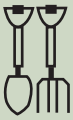
Once they understand that this methodology brings in economic considerations as well as physiological ones, they became far more interested in what this approach has to offer.

The value chain approach considers impacts that can range from access to land and the effectiveness of input supplies, through farm production and postharvest storage and processing, on to the journey to market and the final consumer. It explores the detail of each of these various stages and the stakeholders involved at each stage. It also explores the transactions, the value addition in financial terms and the relationships different parties that negotiate along the chain.

This approach provides an understanding of the key opportunities and constraints along the value chain. It can help identify which actions, aimed at addressing the constraints or opportunities identified, will:

- have a higher or lower impact;
- take a longer time to address and which can be addressed relatively quickly; and
- whether there are ‘low hanging fruits’ (i.e. Issues that are both and easy to address and addressing them will have a high impact).

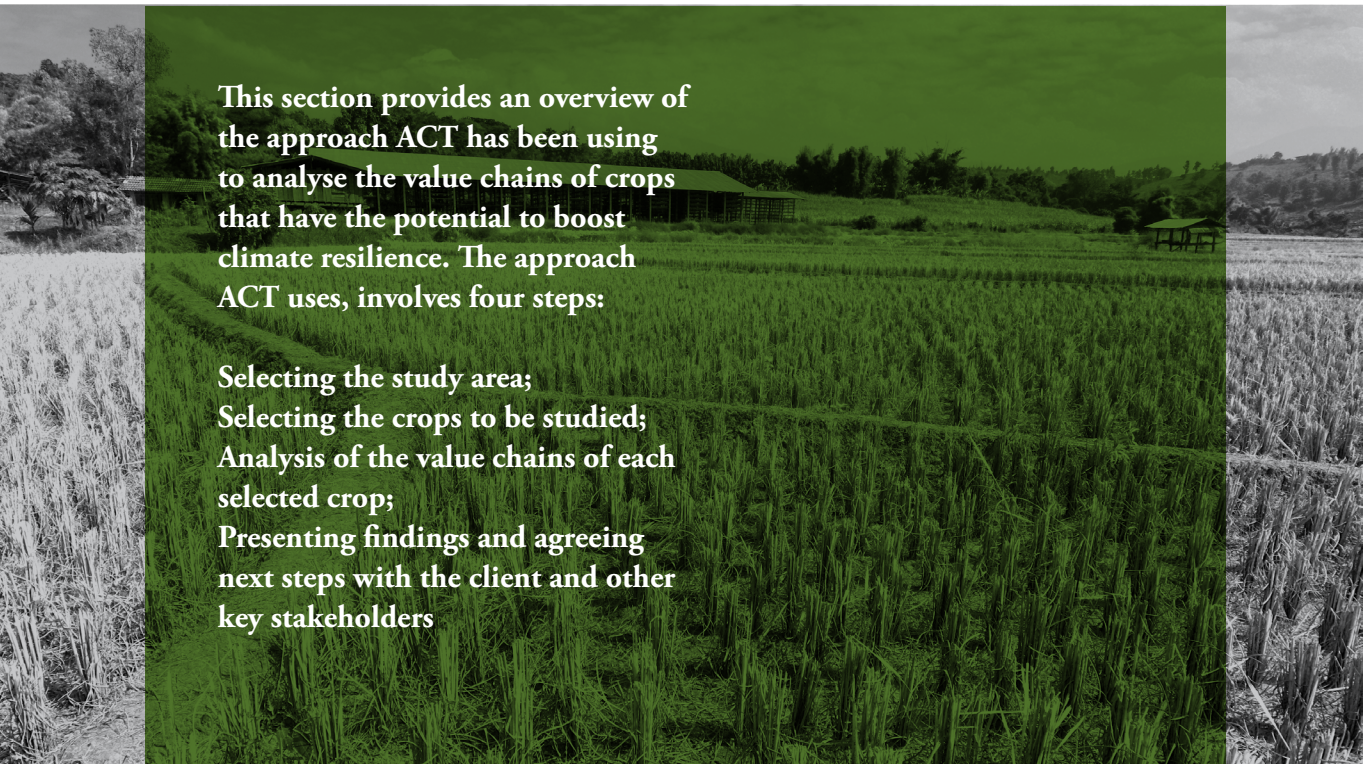
Figure 1: Example of the impacts of climate change on an agricultural value chain

Inputs	Production	Processing	Marketing	Consumption
				
• Reduce seed quality (poor germination) • Delayed delivery (non/low availability of resilient varieties)	• Reduce yield • Crop failure • Poor vegetative growth/stunting/ rotting • Excess labour needed for weeding, harvesting, drying	• Reduce quantities available for agro-processing • Poor quality harvested crop leads to poor quality processed product • High moisture content - lower prices for farmers, and higher losses in processing • Delayed delivery / distribution	• Congestion or damage to transportation routes • Losses due to rotting • Delayed distribution	• Reduced food availability • Price volatility • Higher price

Source: Based on Dekens and Dazé (2016). Policy Solutions for Climate Resilient Agricultural Value Chains[1]

1 Dekens J. and Dazé A. (2016). Policy Solutions for Climate Resilient Agricultural Value Chains, IISD Blog, International Institute for Sustainable Development. https://www.iisd.org/blog/policy-solutions-climate-resilient-agricultural-value-chains

METHODOLOGY OVERVIEW

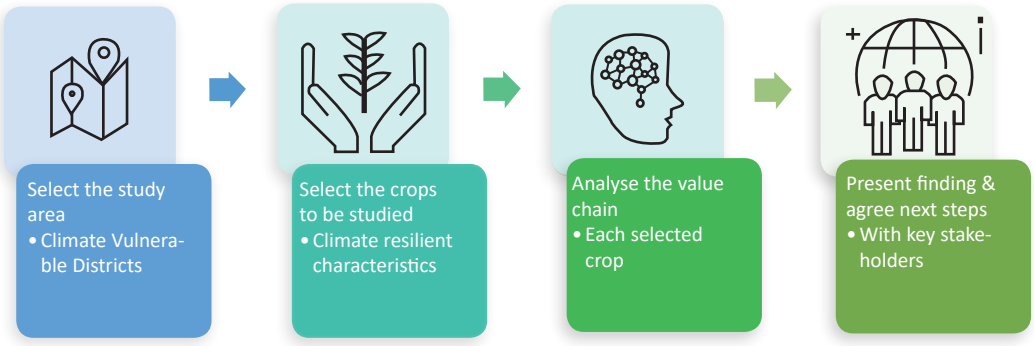


This section provides an overview of the approach ACT has been using to analyse the value chains of crops that have the potential to boost climate resilience. The approach ACT uses, involves four steps:

Selecting the study area;
Selecting the crops to be studied;
Analysis of the value chains of each selected crop;
Presenting findings and agreeing next steps with the client and other key stakeholders

Multi-criteria analysis (MCA) is used to for steps 1 and 2, and a form of value chain analysis (VCA) for step 3. Step 4 is manged through consultative feedback, using validation workshops to present results, recommendations and agree next steps. This section provides an overview of the overall approach. Detailed, practical guidance in using MCA and VCA methodologies is provided in Sections 3 & 4.

Figure 2: Steps of value chain analysis approach



i. Selecting the study area

ACT has been using MCA to identify climate vulnerable regions as locations for studies of the value chains of climate resilient crops. In this context, local climate vulnerability has been a major factor in selecting the study areas. The study area is usually a province or a district (in practice it is often one or more neighbouring districts that share very similar climatic conditions).

If there has been no prior assessment of the agricultural sector's climate vulnerabilities, then some kind of

assessment needs to be included to assist in selecting study areas. However, this need not be a very long-winded task as, in practice, some level of assessments often already exists (for example, work done by local agricultural universities or similar research organisations).

Climate vulnerability is not the only yardstick used to select locations, so multiple criteria are identified that include for example, the number of small and vulnerable farm households. These are then weighted, as some are more important than others, to make a final set of criteria that can be used for selection. This selection process draws on a combination of expert opinion, existing data and the final selection agreed in consultation with the key partner - for ACT this is a ministry / department of Agriculture. (More detail on using a multi-criteria selection process is provided in **Section 3**, below).

ii. Selecting crops to study

Following on from selecting the study area comes identifying the crops for VCA. In this stage, a 'long list' of potentially resilient crops is drawn up. Depending on the location's particular climate vulnerabilities these will be crops (or specific varieties) that have characteristics such as drought-, heat -, flood- or salt-tolerance. Once again this 'long-list' is drawn up using expert consultation ('experts' might include local agricultural scientists, farmers organisations and local agriculture department staff) combined with secondary data.

The long list is then filtered through a multi-criteria analysis (MCA) selection process to arrive at a 'short-list' of crops. Once again, the criteria used are determined through consultation with relevant stakeholders. The number of crops on the final short-list is mainly determined by the time and resources available for study. In ACT's case this ranged from two to six crops. A final stage before undertaking value chain analysis of the selected crops, is to agree the short-list with the client - in ACT's case, this is a ministry / department of agriculture.

At this stage, final adjustment to the short-list are made, in consultation with the client where final selection is agreed. For example, sometimes the difference in MCA scores between two crops is very close. It may be that a crop that narrowly fails to make the short-list may replace one that has been initially selected, because it is regarded by the government as more important for political, economic or social reasons.

iii. Value chain analysis

Value chain analysis requires a multi-disciplinary team to undertake both desk-based studies and extensive field work. Ideally a team will be comprised of an agriculture specialist who has experience of working on climate change, an agricultural economist, a marketing specialist and a social scientist with a good understanding of gender issues in the agriculture sector and the region. The team needs to have skills in designing and undertaking social surveys, using methods such as questionnaire-based surveys, semi-structured interviews and focus groups.

The analysis is underpinned by a combination secondary data and first-hand information gained from interviews and observation. The aim is to understand the social and financial dynamics at each stage of the value chain of the specific crop being studied. (e.g. identify the key stakeholders and how they interact; how negotiations take place; how information is obtained and understood; what blockages exists that have an adverse impact on the way the value chain currently operates; and what opportunities can be exploited to ease and improve the commodity's journey along the value chain).

It is possible to follow more than one crop's value chain during a single round of field work but, in this case, it is important to clearly differentiate the different crops during stakeholder analysis and interviews. More than one round of field work is often required to fill gaps that emerge during the initial stage of analysis.

Table 1: What value chain analysis can and can't provide

VCA provides	Why it is necessary to augment VCA
• A good understanding of opportunities and constraints / strengths / weaknesses along the value chain	• VCA is not an end in itself. It just provides evidence to support decision making.
• Mitigates against focus on just one component of the value chain.	• A focus on what happens within the individual stages along the VC can risk losing sight of the bigger picture, where the linkages between the different stages are important factors.
• Highlights the linkages between the different stages of the value chain	
• It often identifies gaps that need further analysis to understand the detail of what's required to address the Identified problem	• VCA does not necessarily indicate which constraint to attend to first – Often requires some further analysis / discussion to make sense of the story from emerging from the VCA

iv. Presenting findings and agreeing on next steps

It is vital to take the findings that emerge from a VCA exercise and share and discuss these with stakeholders. Without this final stage, the analysis risks becoming nothing more than a report gathering dust on bookshelves. If we wish to see MCA and VCA methods as tools, this final stage is where the tools get used - to inform decision-making on implementation and policy reform.

Presenting results is not simply circulating a final report and should include discussion of the findings and their implications. It should include agreeing 'next steps' and initiate the process of planning and implementing actions to open up the value chain(s) under study.

The remainder of this paper describes the methods used for both MCA and VCA in more detail. These descriptions are illustrated with experiences from the ACT programme.

MULTI-CRITERIA ANALYSIS

ACT has been using multi-criteria analysis as a tool to select both climate vulnerable districts and potentially climate resilient crops for study using a value chain approach. MCA is a useful tool because it can be applied to support complex decisions, helps focus on the important issues and, importantly, is very easy to use.

Introduction

Decision-making can be a complex process when several competing factors need to be considered. MCA simply divides a complex decision process into smaller parts that are easier to understand. Then, each of these parts is analysed separately. Finally, the separate parts are reintegrated to provide a solution that address the range of criteria.

MCA helps:

- Choose between competing alternatives;
- Examine a problem against various parameters/criteria;
- Cross-examine multiple economic, social and political impacts;
- Understand the trade-offs between various criteria;
- Provide a practical alternative to cost-benefit analysis that can be used when many, or all, variables do not have clear financial values.

MCA helps people think, re-think, query, adjust, decide, rethink some more, test, adjust, and finally decide"[2]

2 Natural Resources Leadership Institute. 2018. Multi-Criteria Decision Analysis. Available at: https://projects.ncsu.edu/nrli/decision-making/MCDA.php

Methodology

MCA is composed of a sequence of 6 steps:

i. Define the objective
ii. Identify the key issues that primary stakeholders see as important to consider in order to achieve the objective
iii. Develop criteria to asses these alternatives
iv. Weight the criteria (taking account of primary stakeholders' views)
v. Score the criteria
vi. Discuss the results, adjust scoring if necessary, before making a final decision.

i. Define the objective

MCA is used in ACT's climate resilient agriculture (CRA) work for two purposes:

i. to identify a study area; and
ii. to identify crops for study, using value chain analysis.

ACT did not use MCA to select study areas in every case. Where existing agro-climatic vulnerability has already been identified by others, it was possible to leave out this step and simply use the existing analysis as a guide to identify study areas.

BOX 3

SELECTING CLIMATE VULNERABLE DISTRICTS FOR THE STUDY

In Pakistan's Punjab and Sindh provinces, no previous work had been done on to identify the most climate vulnerable districts. The ACT team used multi-criteria analysis to select the districts to be the focus of their VCA work. They used criteria such as crop cover, drought vulnerability, flood risk, temperature, the number of farming households and the proportion of small farmers, along with the government's malnutrition and multi-dimensional poverty indexes. Each criterion was given an individual weighting. The team were careful to use criteria where suitable data was readily available - so the task of selecting districts to focus on was neither difficult nor time consuming.

Identifying crops for study using MCA will be used as a 'worked example', below (see Figure 2) . Here the objective is to identify a set of crops for study that have appropriate climate resilient properties within the context of the climate vulnerabilities of the study location. (E.g. if climate change projections indicate an increase in the frequency and intensity of droughts, then crops / varieties that are 'drought tolerant' will comprise the initial 'long list' that will then be narrowed down through the MCA process).

In Assam, Maharashtra and Odisha information already existed on different district's vulnerability to climate change impacts. ACT used this information to select particularly vulnerable districts for the value chain studies as, in these locations, the need to identify climate resilient cropping options is particularly acute.

ii. Identify the key issues that primary stakeholders see as important

This step is undertaken through a combination of consultations and expert knowledge. For example, if climate change projections indicate an increase in the frequency and intensity of droughts, then crops / varieties that are 'drought tolerant' will comprise the initial 'long list' that will then be narrowed down through the MCA process.

Key stakeholders are agriculture department staff (ACT's primary client for this work) along with local experts such staff of agricultural universities. Because ACT uses local consultants as much as possible for these studies, the consultant team also have the skill and experience to directly contribute to identifying a 'long list' suitable local crops.

iii. Develop criteria

In order to assess the key issues, a set of criteria are developed, again this is done in consultation with key stakeholders and aided by expert judgement.

In the case of climate resilient crops these could be:

- Input requirements (low input rather than high input)
- Management practices (suitability for small farmers' existing skills tools/equipment);
- Economic returns;
- Tolerance to the local climatic risks;
- Contribution to socio-economic benefits;
- Environmental impact of cultivation (low impact rather than high impact);
- Contribution to self-sufficiency; and
- Opportunities for export or import substitution.

Figure 2, below, provides an example of the criteria used in ACT's work in Pakistan. It also shows the different weighting used in that case. This example is not a blueprint and may need to be adjusted to suit local priorities or specific climate risks. But it does provide a base that can be used to select a set of criteria.

For many of these major criteria there are a set of sub-criteria. These are also identified. **Figure 2**, below, shows an example of criteria along with sub-criteria. As illustrated, the criteria 'Economic returns' is comprised of two sub-criteria, 'profitability' and 'marketability'. Note that several, though not all, of the main criteria are comprised of sub-criteria.

It is important to identify the source, and confirm the availability, of the data required to measure any of the chosen criteria.

iv. Weight the criteria

Not all the criteria are of equal importance. A judgement has to be made on this, again this is done through a combination of consultation with the key stakeholders and expert opinion. The total weightings for each of the criteria must add up to 100 and is used to adjust the final scoring.

In the example shown in **Figure 3**, there ae seven criteria used to guide selecting crops to study. If all were considered equally important, each would have a weighting value of 14.3 (!00 ÷7). However, a judgment has been made that some criteria are more important than others for the purposes of this particular study. So, both *'Environmental impact' and 'Economic Returns'* are given an increased weighting of 20. This is because the sub-criteria for environmental impact include biophysical responses that are relevant to climate resilience and without an economic incentive, farmers are unlikely to increase the cultivated area of any crop. *'Self-sufficiency'* and '*Opportunities f*or Export or Import Substitution' are also given higher weightings because these are high political priorities for government.

Annex 2 provides fuller information on the data used in Pakistan to weight the criteria shown in Figure 3 and this example should be consulted as a guide to weighting which can be adjusted to suit local requirements and data availability.

BOX 4

IMPORT SUBSTITUTION THROUGH BOOSTING CANOLA PRODUCTION IN PUNJAB, PAKISTAN

In Punjab, Pakistan, canola emerged as one of the 'climate resilient' crops when a long list of field crops was assessed against a range of environmental and economic criteria. In this case a significant weighting was assigned to crops that have the potential to either expand exports or substitute for imports. A primary objective for selecting both climate-based and economic parameters was to ensure a balance between enabling shifts to climate resilient options and enhancing both farmers' livelihoods and the province's economy.

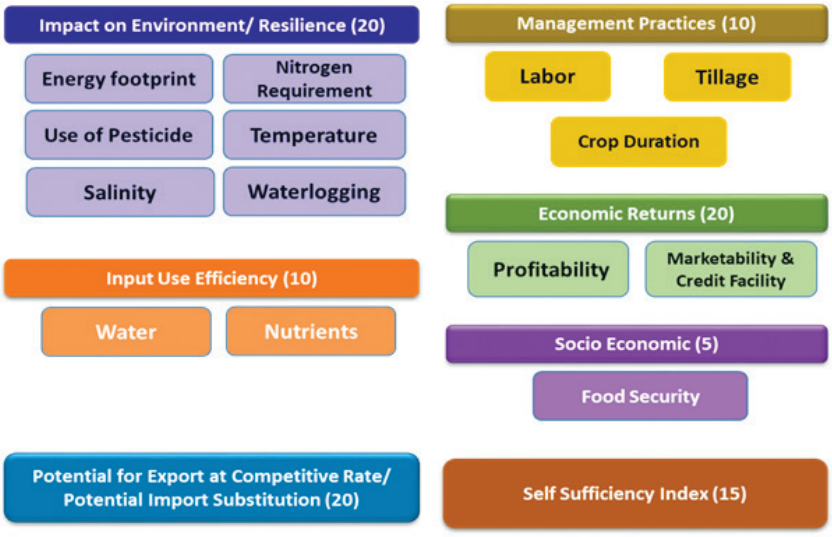
Canola is a relatively easy crop in terms of farming practices and input requirements. It is highly resilient to changes in rainfall patterns, temperature and humidity and can be grown in a wide range of soil types.

Currently, Pakistan imports oilseeds - soybean, sunflower and canola. Amongst these, canola imports are around 800,000 – 1,200,000 MT per annum. Boosting domestic production of canola in the near future can potentially replace close to half of Pakistan's canola imports. The study also found that with the current productivity levels, Punjab has the potential to achieve this goal and increase the area under canola from around the current 17,800 hectares to 400,000 hectares.

The study did identify blockages in the Canola value chain – around both technology and information. For example, many farmers do not plant, and sometimes are unaware of, high yielding varieties; machinery designed for wheat, rather than specifically for canola, is commonly used. These blockages need to be addressed if the potential gains in yield are to be achieved. One of the study's recommendations highlights the need for formulating a comprehensive 'canola policy', and a multi-faceted strategy to help ease existing blockages across its value chain and provide adequate incentives and support to canola farmers.

It is possible to rank each of the sub-criteria too, not just the main ones. A judgement needs to be made whether this will add value to the exercise, or whether each sub-criterion has (in the context of the key criteria it links to) very different impacts, or whether they are of roughly equal importance. In Figure 2 only the key criteria are weighted.

Figure 3: Short Listing Climate Resilient & Environment Friendly Crops using Multi-Criteria Analysis (MCA) - An Example from ACT's work in Punjab, Pakistan



v. Score the criteria

Scoring is done using an ordinal scale, usually a 4-point or 5-point scale. For example, a five-point scale might be: 5 = excellent; 4 = good; 3 = satisfactory; 2 = below average; 1 = poor. Each criterion and sub-criterion is then rated for how well it satisfies addressing a particular constraint. For example, if the main climate vulnerability identified in the study area is an increased flood risk, a crop that can withstand waterlogging would be scored 4 or 5. Annex 2 shows how data was used for scoring in Pakistan, where the team used a four-point scale.

The final scores for each of the main criteria are then adjusted in line with the agreed weightings. In this way each individual crop returns a final score that allows each to be compared with one another.

vi. Discuss the results, adjust scoring if necessary

The final scores will provide a ranked listing of all the crops included in the MCA. The highest ranked would normally be the ones selected for further analysis using a value chain approach. How many are selected for further study depends on the time and resources available. In ACT's case, usually between 2 and 5 crops were selected for the initial VCA study.

Scoring is not an exact science. Particularly as the choice of criteria and the weightings are selected through a subjective process – i.e. a selection and weighting of priorities as perceived by a small group of 'experts'. Crops with close scores will be good candidates for further discussion.

The most common reason for making final adjustments is to provide the most useful set of crops for possible policy or implementation reforms. It may be that a crop that is regarded as very important for economic or political reasons does not quite make the final selection based purely on MCA scores. This can then be discussed with the key stakeholders and the final selection adjusted. Usually this would be done at the margins – with perhaps one crop added and another removed from the initial final ranking.

Figure 4 shows a worked example for crop selection in Punjab, Pakistan. (Annex 2 illustrates a detailed example of weighting criteria and sub-criteria for mung bean, one of the crops selected for the analysis). In Figure 4 all the criteria were tabulated with respect to each crop and the total score was the weighted average of all criteria, calculated after incorporating the weights assigned to each factor. The ranking of each criterion was within the range 1-4. In the final ranking, canola and gram top the list of 'rabi' crops, and mung bean and sesame (sesame) are top ranked among 'kharif' crops.

The actual criteria used, and weighting given to each is not fixed and should be adjusted to suit local conditions using expert judgement. Importantly, the criteria selected must draw on good quality data sets that can be easily obtained. Usually this data is drawn from existing surveys or other data sets. These can range from government development statistics, climate monitoring data or other credible studies conducted and published by multilateral or domestic organisations. In some cases, especially when there are data gaps, necessary data for one or more criteria can be obtained from key stakeholders during field work.

Figure 4: Prioritisation of Rabi and Kharif crops in Punjab, Pakistan

		Temperature	Salinity	Water Logging	Energy Footprint	Nitrogen	Pesticide	Crop Water Requirement	Nutrient Requirement	Labor	Tillage	Crop Duration	Profitability	Marketability	Food Security	Export Potential	Self Sufficiency	Total
Rabi Crops	Sunflower	3	3	1	2	3	3	1	3	2	4	3	2	2	2	4	4	6.6
	Maize	1	2	1	3	1	2	1	1	1	1	3	4	4	3	1	1	4.8
	Gram	2	3	2	3	4	4	2	4	3	4	4	1	3	3	3	2	7.15
	Rapeseed/Canola	3	3	3	3	3	3	2	3	3	4	1	2	3	2	4	4	7.4
	Wheat	3	3	1	2	2	3	2	3	3	2	3	2	1	4	1	1	5.35
Kharif Crops	Cotton	3	4	1	1	1	1	2	2	1	2	1	4	4	1	4	3	5.9
	Rice (Paddy)	2	2	4	2	2	3	1	2	1	1	2	4	4	4	3	1	6.25
	Moong	3	2	2	3	4	3	4	4	4	4	4	1	2	3	1	2	6.65
	Sesamum	3	2	2	3	3	3	4	4	3	3	4	1	2	2	3	1	6.6
	Millet	2	3	2	3	2	4	2	4	3	4	4	1	2	2	1	2	6.1
	Maize	1	2	1	3	1	2	1	1	1	1	3	4	4	3	1	1	5.8

Table 2 demonstrates the same methodology for selection of climate vulnerable areas in Assam, within which crops were then selected. The criteria used for area selection in Assam were focused on climate change- such as assessing the availability of climate information, future climate impacts and water resource management, and on the broader socio-economic and agricultural context. Once areas were selected based on these criteria, the MCA used crop specific information to select crops for their value chain analysis. The full set of criteria used in this case is shown in Annex 3).

Table 2: Prioritization of agro-climatic zones in Assam - an example of criteria used to score 'climate impacts'

Criteria	Score for sub criteria	Sub criteria	W*	LBVZ		NBPZ		UBVZ		CBVZ		HZ		BVZ	
Climate (30)	4: Nil 3 :< 5 years 2: 5 – 10 years 1: > 10 Years	Availability of quality weather information for 30 years	4	1	4	1	4	1	4	1	4	1	4	1	4
	4: Very high 3 : High 2: Medium 1: Low	Exposure to extreme rainfall events (Floods / droughts)	9	3	27	3	27	2	18	3	18	3	27	1	9
	4: Very high 3: High 2: Medium 1: Low	Exposure to extreme temperature conditions (Hot / cold)	5	4	20	4	20	3	15	3	15	2	10	1	5
	4: < 4 months 3: 4 – 7 months 2: 8 – 10 months 1: > 10 months	Water availability for crop production	6	2	12	2	12	2	12	2	12	1	12	2	12
	4: Very high 3: High 2: moderate 1: minimum	Future climate change impacts	6	3	18	2	12	2	12	2	12	2	12	2	12

*Note: W represents the weighting of each sub-criteria. The individual score (1 - 4) for each is multiplied by this weighting to give a final score.

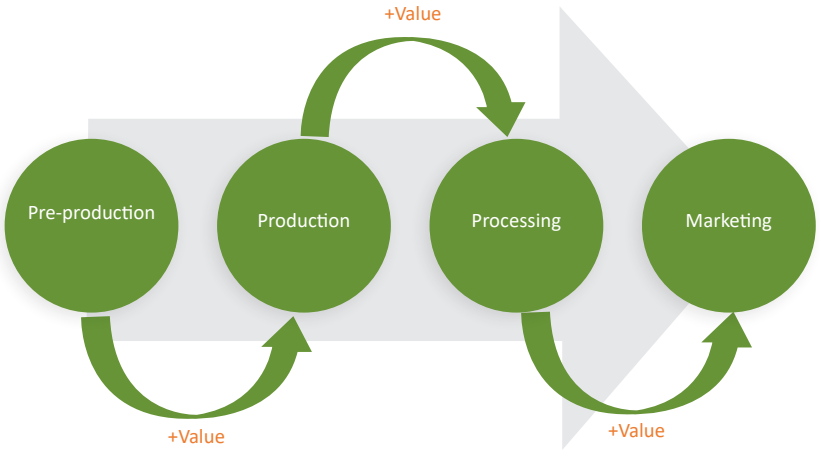
VALUE CHAIN ANALYSIS

Introduction

A 'value chain' in agriculture describes the range of activities and set of actors that bring an agricultural product from production in the field to final consumption. At each stage value is added to the product. See Figure 5, below.

Successful agricultural value chains are both productive and sustainable. The various processes and stages along the value chain work together to conserve the environment and natural resource base; adapt to climate change; respond to price fluctuations and consumer needs; and provide sustainable pathways to sufficient, nutritious and affordable food or other agriculture-based products.

Figure 5: A simplified illustration of an agricultural value chain



Value Chain Analysis (VCA) investigates all the factors which affect the activities of the actors in a value chain. VCA helps us to identify:

- the value added by different actors at each stage of the value chain (through cultivation, processing, packaging, transporting, marketing, etc).
- key actors and their relationships
- enterprises which contribute to production

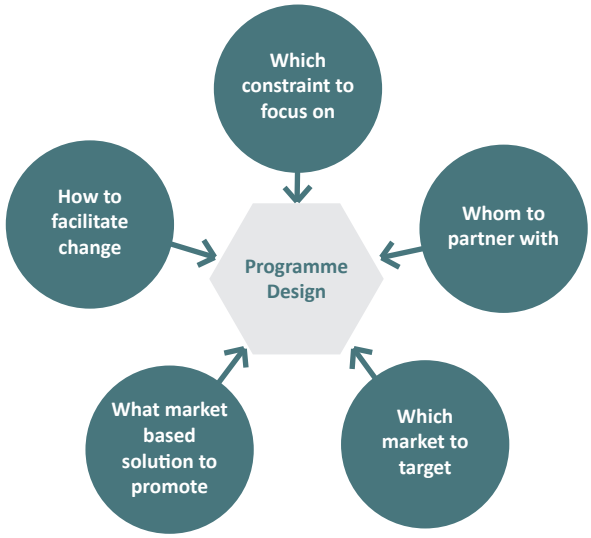
- bottlenecks preventing progress
- strategies to help local enterprises compete
- relevant stakeholders for planning and policy

VCA provides answer to:

- What keeps the actors together?
- What is the relationship among them?
- What interventions would improve the flow of products and / or value addition along the value chain?

In the context of any particular crop's value chain, having an understanding of the key actors' roles, incentives and relationships supports decision-making on policies or actions that can improve the flow of value addition along the chain. For example, VCA can be used to identify opportunities for intervention, such as providing access to finance, markets or technology; or improving institutional or policy frameworks or the business environment.

Figure 6: Understanding actors and relationships in a value chain helps programme design



Climate and agricultural value chains

Why follow a 'Value chain approach' to build climate resilience?

- In agriculture, climate risks are business risks;
- Climate risks do not only occur on the farm;
- Climate impacts affect all actors along a value chain;

The impacts of climate change along agricultural value chains have been discussed in Section 1. Climate hazards such as droughts, floods and changing rainfall patterns have impacts on all actors of a value chain, but in different ways and to different extents. Most actors make some effort to reduce the negative impacts of climate and weather hazards on their activities, but not all responses are affordable and/or sustainable. In addition, any lack of communication and trust between and among actors along the value chain can hamper attempts at climate adaptation.

The analysis of climate impacts and responses along the value chain can be done by using qualitative and participatory approaches to understand the different value chain actors' perceptions of climate impacts and their responses.

BOX 5

WHY COTTON WAS SELECTED FOR STUDY IN BANGLADESH

ACT has used this methodology to study the value chain of sets of potentially 'climate resilient' crops (identified through a MCA exercise) with the objective of identifying ways to promote and expand production of these crops.

In Bangladesh the ACT team followed a rather different approach to using VCA. During initial discussions, the Ministry of Agriculture clarified that they wished to first focus on cotton. Cotton is an economically important crop and a major input to the country's large textile industry, but only a small proportion of the cotton required by industry is actually grown in the country. The government wants to expand cotton cultivation to reduce imports. In this case the objective of the VCA study was to understand the climate risks to expanding cotton production. If cotton was shown to be relatively resilient to climate impacts, then the value chain approach would also add value by identifying opportunities and constraints to increasing local cotton production.

Methodology

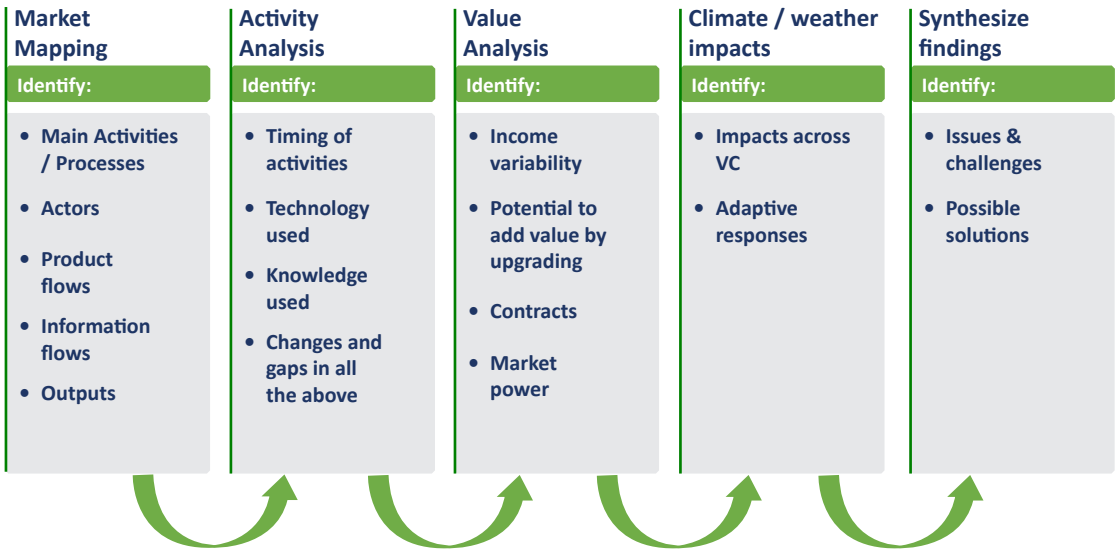
There are five steps involved in VCA that that incorporates climate change impacts (see Figure 7 below). These are not necessarily discrete steps that necessitate certain sequencing. In practice they frequently overlap. Often the full range of information requires revisiting certain locations or gathering more information. The five steps are:

1. Market mapping
2. Activity analysis
3. Value analysis
4. Assessing climate and weather impacts along the value chain
5. Synthesizing the findings to identify the key bottlenecks and opportunities for intervention

Although some information is gathered using secondary data, the bulk of the required information has to be collected in the field. As there are a range of social, technical and economic factors to consider, agricultural VCA requires a multi-disciplinary team that brings together expertise on agriculture, economics, governance and social development and agricultural marketing.

There are a number of survey and analytical tools that are used to gather information through the VCA. These are briefly described below. More detail on how these methodologies can be used at each of the five main VCA steps is provided in in the following sections, as part of the description of how to undertake each of the five steps.

Figure 7: Methodology - Key information used in each of the five main steps



Tools for Value chain analysis

There are no fixed rules as to how value chain analysis should be carried out. A range of qualitative and quantitative research tools are used. The most suitable tool is selected for the various sets of information that are required:

Qualitative

- **Semi structured Interviews:** Combines a pre-determined set of open questions with the opportunity for the interviewer to explore a particular theme. Semi-structured interviews are often with just one person or a very small group.
- **Focus group discussions:** Group discussions, guided by the moderator using pre-determined, semi-structured guidelines. The format is flexible enough to allow exploration. Usually, several groups of 8 to 10 people who have a common interest or experience are selected. Focus group discussions can save time and money compared to individual interviews and they can often provide a broader range of information.
- **Participant observation:** The researcher interacts in a range of day-to-day activities with a group. The aim is to gain close familiarity with the group, and their practices, concerns and aspirations, through direct and close involvement. This can be a very time-consuming process and is rarely used in rapid field surveys.

Quantitative

- **Structured Questionnaires:** These use predetermined questions with little scope to explore beyond the questions and language used in the questionnaire. There is low level of involvement of the researcher, but a large number of people can be covered. Questionnaire surveys are well suited to collecting numerical information, such as costs and revenues, weights of product, distance to markets and so on.

Both Qualitative and Quantitative

- **Market Mapping:** This gathers information on various market conditions and market players to understand how money and products flow, the relationships between the different actors in the market, and the services that support them. It also takes account of how infrastructure, policies and social norms effect the way that markets operate.

The following sections describe the various steps use in the VCA methodology and provide some worked examples. In addition, an example of a full survey forms used in field work are provided in **Annex 1.**

vii. Market Mapping

This section provides methods for understanding the key actors, activities, and processes across an agricultural value chain.

By following these steps you will be able to: :

- Make a 'value chain map' matrix;
- Map core value chain activities and processes;
- Identify the main value chain actors;
- Identify linkages between value chain actors;
- Map the flow of products and information;
- Map the relationships and linkages between value chain actors;
- Map the services that feed into the value chain;
- Identify rules and regulations that impact on the value chain.

Market mapping is a useful initial activity in a VCA, as it allows the team to understand the whole value chain and provides a framework against which to explore issue that impact on the way a particular value chain functions. Value chain maps are particularly useful for identifying the key actors along the chain, the relevant activities they take part in and their relationships with each other.

Making a value chain map matrix

A simple way to begin the market mapping exercise is to develop a 'value chain matrix'. This matrix can then be used to design the value chain field work survey and questionnaire, as well as determining suitable locations to concentrate on and the key value chain actors to interview. An example of a value chain matrix is shown in **Table 3.**

Table 3: Example of a value chain map matrix

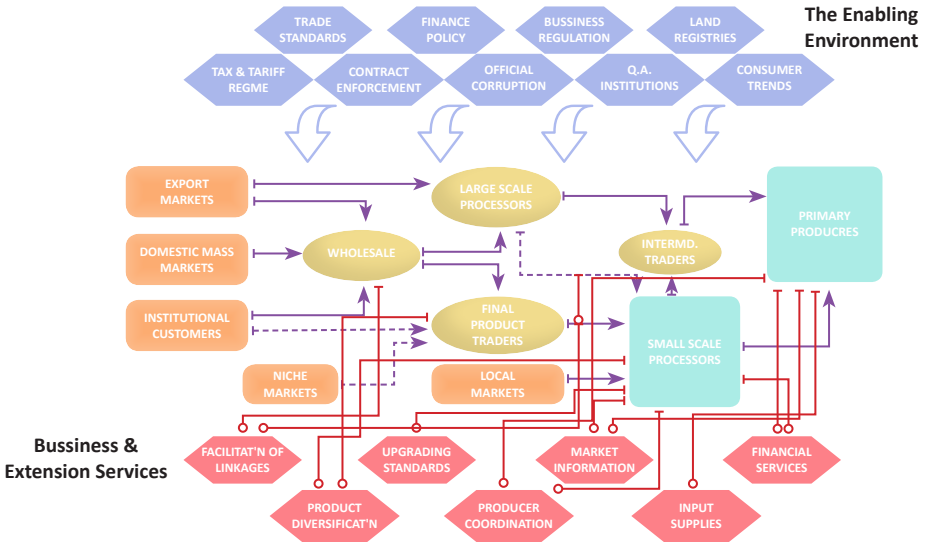
	Pre-Production	Production	Primary Value Addition	Processing	Marketing
Activities	Seed, fertiliser and pesticide supply	Cultivation, weeding harvesting	Cleaning and drying	Oil extraction	Wholesalers distribution to Retailers
Output	Crop inputs available at planting time	Canola seeds (uncleaned)	Canola seeds, cleaned and dried	Refined Canola	Bottled Canola Oil
Actors	Input suppliers, Farmers	Farmers and farm labourers	Farmers and farm labourers	Intermediary traders; Oil refining firms	Large traders; Small traders; Final consumers
Issues / Challenges	Seed quality	Lack of timely weather information	Lack of suitable store to. keep seeds dry	None	Final retailers adulterate oil
Possible solutions	Support bulking up high quality seed	Improve weather information services to ensure timely forecast	Credit for improving on-farm storage infrastructure;	N/A	Enforce existing regulations and improve inspection

This basic matrix can, through the field work, be further developed into a more sophisticated market map. Much of the information on value chain actors, activities and processes will only be clear once the field work is underway or complete. Much of the process and the use of the associated tools that are described below takes place during and after field work.

An example of a generic market map is shown in **Figure 5**, below. The central panel of the figure maps the markets, market linkages, and key actors. The upper and lower panels illustrate examples of policy and regulation issues (the 'external environment') and support services that are also explored through a VCA in order to fully understand the way the market functions.

There are many ways to visualise a market map and **Figure 5** is simply an example of one. They can be presented as simple sketches or as very complex flow charts. The important point is that they contain sufficient information that can help decision-makers see and understand the main actors, processes and relationships along the whole value chain.

Figure 8: An example of a market map



Source: Hellin J., and M. Meijer, 2006. Guidelines for value chain analysis[3]

Mapping the core value chain activities and processes:

This is the first step in mapping any value chain and involves identifying the major transformational processes along the value chain where value is added. Examples of core processes are: procuring farm inputs; cultivation; storage; processing; marketing. Each of these core processes can then be broken down into set of activities. These then form the 'backbone' of the value chain map and allows the various actors, relationships, support services and external influences to be placed in the correct position on the value chain map.

One way of recording this during field work is to complete a simple process mapping matrix as shown in **Table 4**, below.

Table 4: Core processes matrix

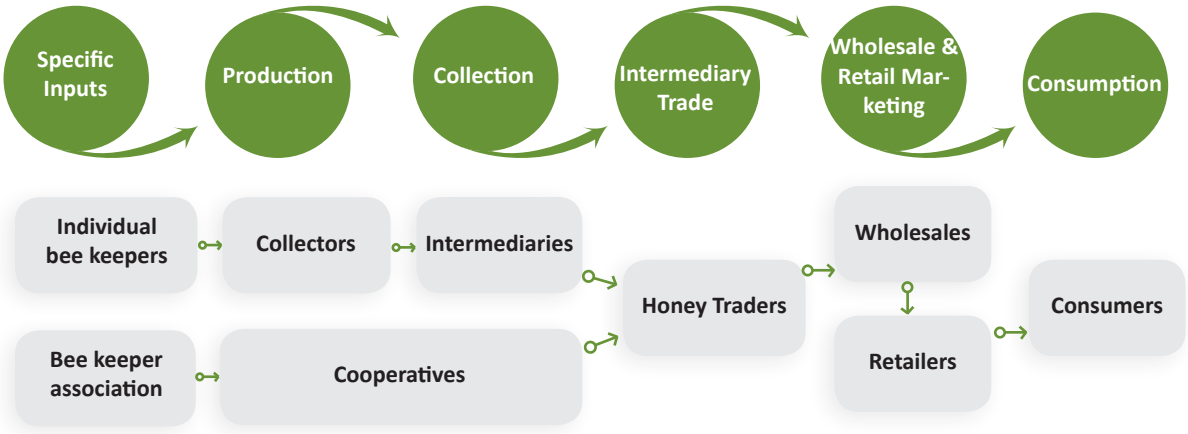
Commodity	Core Processes	Main activities in the core process
Mung bean	Production	Farmer sourcing seeds, sowing, irrigating, weeding, harvesting
	Cleaning and storing	Farm family cleans from pods on mats in farmyard, Store in thatch shelter in farmyard
	Marketing	Transported to local market by ox-cart; Price negotiation between farmer and with Intermediate trader

Mapping the main value chain actors

This is a very straightforward exercise, once the processes along the value chain have been identified. It involves identifying that actors involved, and their role, at each stage of the value chain. An example is shown in **Figure 9,** below.

3 Hellin J., and M. Meijer, 2006. Guidelines for value chain analysis. FAO, Rome. http://www.fao.org/3/a-bq787e.pdf

Figure 9: Example of a map of main actors in honey value chain



Identifying the linkages between actors

However, once these actors have been identified, it is necessary to understand the relationships between them. This is usually best done through semi-structured interviews in separate focus groups, each representing the main actors. It is important to understand both vertical and horizontal linkages between groups of producers or traders.

Vertical linkages are those relationships that are required to manage the sequential steps along the value chain. For example, from farmer to intermediary trader to wholesaler. **Horizontal linkages** are those between individuals or groups that operate at the same part of the value chain and have some common interest. For example, the relationships between neighbouring farmers, or the relationships between agro-processors dealing with the same product

These linkages can be analysed by exploring: the objective of the actors; how this links to the value chain in question; how satisfied they are with the working relationships that relate to the value chain; and whether they operate within the value chain as individuals or as a group. If they operate as a group, then: the size of the group; the benefits of participating in the group; formal and informal governance mechanisms, including the levels of trust within the group; how effective the group is at meeting their objectives; and whether there are potential opportunities for the group to add value (or increase the value it already adds) in the value chain. (**Annex 1** provides an example of field survey forms, including guide questions for exploring linkages between different value chain actors).

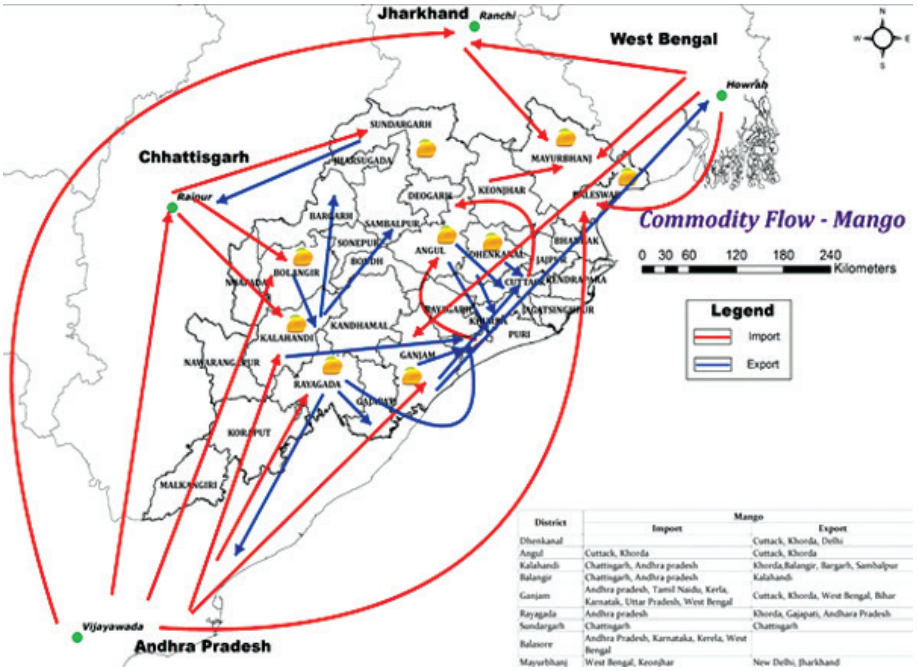
Mapping the flow of products and information

In this step the 'product' at each stage of the process is identified and the path from one stage of the chain to the next. **Figure 9**, above, illustrates an example of a product flow. In the field, information of product flows can be simply collected in a matrix, as shown in **Table 5,** below. Physical flows of a product can also be indicated on a physical map, as shown in **Figure 10** below.

Table 5: Product Flow Matrix

Commodity	Place of origin / production	Place of sale	Volume / Quantity
Mango	Kalahandi	Sambalpur	10 MT
	Kalahandi	Puri	17 MT

Figure 10: Product flow of Mangos in Odisha, India



Source: ACT, (2018). Operational Strategy for Climate Resilient Value Chain Development of Mango & Arhar in Odisha., ACT

Knowledge and information flows can be mapped in a similar way. This will allow the mapping of way the various value chain actors obtain information on important factors such as: market prices; availability and use of inputs; weather information; extension messages; and farmer-to-farmer learning.

Mapping the relationships and linkages between value chain actors

This involves gaining an understanding of each key stakeholder's area of influence, as well as their relevant interests, capacities, resources and relative power. The purpose is to understand the key relationships in the chain and whether they are working well. If later analysis indicates that changes are needed at any particular point in the chain, any recommendation needs to take account of the importance of these stakeholders to any change process; their likely response to change; the incentives likely to encourage them to behave differently; and whether they are powerful enough to either support or block change.

Mapping the services that feed into the value chain

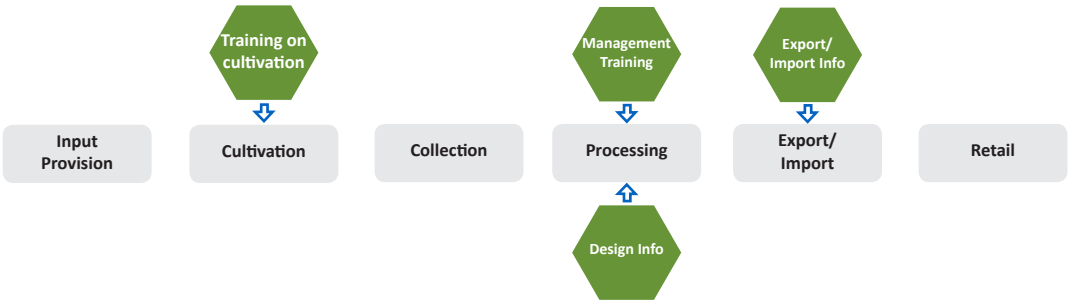
Mapping services helps identify the potential for interventions outside the value chain. For example, this might include training, information or financial support that has an impact on the performance of the value chain. These can be recorded in matrix such as shown in **Table 6**, below.

Table 6: Example of a services matrix

Process/ Stage	Service / Scheme / Policy
Input Provision	Seed company advisory service
Cultivation	Extension advice from Agricultural Dept; Organic certification scheme
Collection Aggregation	Local collection by intermediary traders
Post-harvest value addition	None
Export / Import	Govt scheme supporting minimum import parity price
Retail	Organic certification provides improved sale price

Sometimes this analysis will indicate that potentially useful services are missing. Providing services to fill these gaps these gaps will increase the effectiveness of the flow along the chain, or increase the potential value added at particular points along the chain. **Figure 11**, below, provides an example of how adding support services could support a hypothetical value chain

Figure 11: Example of a VC map showing opportunities for support services



Identifying rules and regulations

Rules and regulations can have a large impact on the way a value chain operates. They can have both positive or negative impacts - encouraging value addition, or conversely restricting flow along the chain and extracting potential surplus.

To fully understand the way that regulations and rules effect a value chain, it is necessary to identify the rules which influence actors in the value chain. Once this is done it is possible to find out, for each rule or regulation, the actors that set them; the reasons behind them; how they affect different categories of actor; how different actors know about them; the sanctions for any non-compliance; and if, how and why the rule or regulations changes.

Table6: :Example of types of rules and standards affecting a value chain:

Type	Example	Enforcement and sanction
Official "legal "standards	Prohibition of pesticides residue on imported vegetable products	Ban of non-compliant products from destination market
Voluntary Standards	Production requirement for organic certification and labelling	Ineligibility for certification or value-added labelling
Commercial Requirements or Norms (Rules of Trade)	Tangible product requirement such as volume, size, colour, composition, or freshness, which may be codified or not	Spot rejection of product by buyer at delivery or collection or reduced price acquired by seller(downgrading)

viii. Activity analysis

This section provides methods for understanding the detail of activities and processes you identified in the initial mapping exercise.

By following these steps, you will be able to:

- Know the timing of key activities, and whether these are changes related to weather
- Identify sources of relevant skills and knowledge
- Identify gaps in knowledge and technology and opportunities to address these

Activity analysis provides a listing what is being done (for example, land preparation/ input supply; production; processing and value addition, transportation; marketing). Then, for each activity, information is gathered on detail such as the time taken; resources used; along with data on items such as quantities, prices and distance. In practice, this simply splits an activity into small parts and then analyses its sub components.

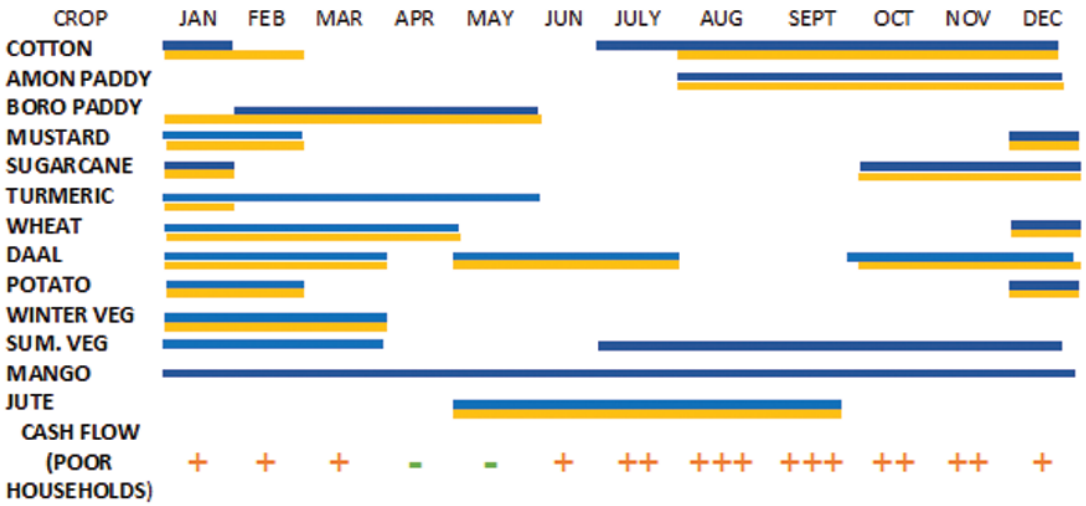
Timing of activities

A simple way to capture basic information about farming practices is to use a seasonal calendar. **Figure 12** shows an example from Bangladesh. This example shows a farm calendar but, if necessary, calendars can also be used to look at the ways traders or markets operate throughout the year.

Climate change often leads to shifts in the timing of agricultural activities, in response to changes in weather patterns. Seasonal calendars provide a useful way to explore shifts in the agricultural year. The example here shows marked shifts in the growing periods of cotton, boro paddy (winter rice) and turmeric.

Calendars can also be used (as here) to capture other information – in this case, the cash flow of poorer households – indicating a 'hungry period just before the main rice harvest.

Figure 12: Seasonal crop calendar for different crops (from informal discussion)



Crop	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Cotton												
Amon paddy												
Boro paddy												
MUstard												
Sugarcane												
Turmeric												
Wheat												
Daal												
Potato												
Winter veg												
Sum. veg												
Mango												
Jute												
Cash Flow (poor householdS)	+	+	+	-	-	+	++	+++	+++	++	++	+

Former crop calendar
Current crop calendar
Cash flow: + have sufficient / surplus;insufficient for basic needs / in debt
Based on: Climate Resilient Agriculture in Bangladesh through Value Chain Analysis of Cotton, ACT 2019

Identify gaps in knowledge and technology and the scope to upgrade or scale up

This step identifies the different uses and users of current technologies in the value chain. For each process along the value chain, the levels of knowledge and technology being used is mapped for the different users, disaggregating between poor and non-poor users. This information can be captured in a matrix similar to the example in **Table 7**.

Table 7: Exploring knowledge and technologies: an example

	Production		Processing	
	Knowledge	**Technology**	**Knowledge**	**Technology**
Poor User	Indigenous knowledge on upland growing conditions	Local Varieties	Indigenious Knowledge	Open air drying and home store in bags
Non-poor user	Upgrade knowledge from extension training	Heigh yielding short duration varieties from department	Knowledge from formal studies/ training	Mechanized processing

If possible, it is useful to actually observe the types of technology used. Questions should be designed to gather information about relevant knowledge levels, the investment required and the suitability of the technology for the purpose it is used. **Table 8** provides some examples.

Table 8: Example of a knowledge and technology matrix

Question	Details to explore
What is the technology you are using to produce your output?	• Primary production: Varieties, Inputs, Equipment / machinery • Post-harvest treatment / storage • Processing: Home based drying/Small scale factory/Large enterprises • Transport: Motorbikes / bicycles /Cars / trucks/public transport • Packaging / labelling
Where did you learn about this technology?	• From generation to generation • From other people in the neighbourhood • From extension (or other) services • Through the media (radio / TV) • Through formal education (yourself or family members)
What investments (capital, labour, land etc.) have you made?	• Capital Investments: • Initial amounts • Maintenance / modifications • Cost to operate the technology • Labour (skilled, unskilled, male, female…) • Amount of time needed to operate the technology • Land • Amount of space required for the technology

Skills, knowledge and technology are not static. There is often room to upgrade, enhance or modernize aspects of each. This can apply to 'processes' or to 'products.

Process upgrades involves improving the efficiency of production. Here it is useful to look at issues such as: whether there are opportunities to reduce cost; speed up delivery; or change inputs while maintaining or increasing production levels (for example: reducing pesticide application without reducing yield, or using stronger cartons to reduce transport losses).

Opportunities to upgrade products can be identified by considering ways in which existing products can be improved, or whether new products could be introduced. For example, will using a more modern mill produce higher quality lentils?

When looking at opportunities to upgrade either a process or product, it is important to identify whether any identified constraint is due to some technical aspect of the technology itself, or due to gaps in the skills and knowledge needed to use a specific technology effectively and efficiently, or a combination of both.

ix. Value analysis

This section provides methods for understanding how value is added along the value chain of an agricultural product.

By following these steps, you will be able to:

- Understand income variability through the year
- Understand what contract exists between key actors
- Identify opportunities for actors to add more value
- Understand the relative market power of different actors
- Identify coping mechanism used to respond to changes in weather patterns

Farmers responses to climate change will always be influenced by the likelihood of either maintaining or increasing the value of their product – whether it is for cash or for subsistence. No farmer will increase their effort or make shifts in their cropping patterns if they are not likely to increase their income (or, at the very least, maintain it). Any attempt to promote climate resilient cropping must take account of the value any change will generate. A change in cultivation techniques or cropping pattern may be a technically appropriate response to address climate risks, but unless incomes can be maintained or increased, farmers will not adopt new practices

This step of the methodology uses interdisciplinary analysis to evaluate how effectively the costs of key value-creating processes are managed and passed on at each stage of the value chain. This includes looking at production, post- harvest storage and processing, exchange, transport, and information flows. Value analysis also provides a means to understand how the relative market power of different actors plays out at the various value chain stages. Overall, it provides a structured approach to identify opportunities to sharpen the efficiency and effectiveness of each stage of the value chain.

Income variability

Assessing income variability over time is an important part of this step. The 'seasonality' of income should be considered, as substantial variations can occur through the year. People may not know, or be willing to share, detailed income information. But information on exact amounts of income is not required. What is important, is simply to understand cash flows (income and expenditure) at different times of year – and this should include all sources of income. The objective is to gain an understanding of the how, for different actors along the value chain, income surplus or deficits impact on decisions and actions through the year. Are there times when expenditures are higher than incomes, or when little cash is available? Does this have an impact on the choices made by stakeholders on how they manage the product(s) under study? As shown in **Figure 12** above, seasonal calendars are a useful way to capture this information directly in the field).

Contracts between key actors

These are the contracts under which participants operate along the value chain. Contractual relationships may be formalised or fairly informal. Any agreements to buy, sell or provide a service along the value chain depends on some form of contract. This includes input provision, marketing, certification, contract farming or outgrowing, as well as the final sale of products. It may also include producer-driven formalisation of collective activities to reduce costs, increase revenues or reduce individual risks.

Understanding how different actors along the value chain interact through these business relationships, and how formalised participation in these relationships are, provides a useful way of identifying and understanding opportunities to upgrade or improve the way contractual relationships function.

To fully understand the workings of contractual relationships, it is important to go beyond simple quantitative data such as the quantities traded and associated prices). Key issues to explore are:

- why certain actors have higher margins and lower costs than others;

- the reasons for any price variations;
- the production capacity of farmers;
- the role of women in agreeing and fulfilling contracts;
- the extent of market information available;
- the accessibility of markets.

Opportunities to add more value

Functional upgrading involves identifying specific activities an actor in the chain should concentrate on. It includes examining whether there are opportunities for a value chain actor to move into a new, higher value-added function or level in the value chain. This is a key aspect of using the VCA to make recommendations on improving the way a value chain functions in practice.

There are no pre-determined questions to ask. Instead, issues that arise from the early stages of information-gathering will form the basis for further investigation. Examples of the sort of questions that might be asked are:

- Should a farmer be a producer, processor and transporter all at the same time, or concentrate on just one or two of these steps to maximize efficiency?
- Can outsourcing certain activities improve efficiency and increase value addition?
- Can a group of small farmers save costs by sharing one small truck to transport vegetables to market?

Market power

An important aspect of value analysis is gaining an understanding of market power, as the ability (or inability) to extract value is often directly related to market power.

Power relations in markets can be examined using the following indicators[4]:

- Control of price levels;
- Market share;
- Collusive activities;
- Analysis of the firm's strengths;
- Analysis of barriers to entry;
- Quantitative measures of market dominance.

- **Price levels:** Is the actor / firm able to set either buying or selling prices on their own?
- **Market share:** This is often a proxy for market power. A high market share alone is not sufficient to indicate significant market power, a firm without a significant share is unlikely to have a dominant position.
- **Collusive activities:** This is where firms / individuals collude to limit competition or maximise profits, for example, by fixing prices and dividing markets.
- **Firm's strengths:** This refers to the extent to which a firm is able to act independently of competitors and customers. Factors that contribute to this include the overall size of the firm, control of key infrastructure that is not easily to duplicated, technological advantages, privileged access to financial resources, a highly developed distribution network, diversified products, economies of scale and/or scope, vertical integration, and the absence of potential competitors or other barriers to expansion.
- **Barriers to entry:** Barriers to entry are costs that new entrants to a market incur but incumbent firms avoid, if these costs prevent new entrants from competing with the incumbent(s).
- **Quantitative measures of market dominance:** Some of the issues listed above can be counted and measured. For example, assessing the number of firms in the market and their market shares, or measuring the degree to which prices exceed marginal cost. Any quantitative measurements of market power must be treated with caution, as comprehensive data can be difficult to obtain, and simple interpretations may provide an inaccurate picture.

4 Source: http://regulationbodyofknowledge.org/faq/market-structure/assessing-market-power-what-is-the-best-factor-to-use-to-determine-market-share-and-assess-dominance/

Coping with adverse weather and climate impacts

Farmers, traders and other actors along the value chain inevitably try to respond and adapt to changes in climate and weather conditions. It is important to capture these activities. **Tables 9 and 10** provide examples of formats that can be used to capture this sort of information. Table 10 only shows an example for a an increase in wet spells, but information on other weather risks, such as dry spells, heat waves, floods, and hailstorms, would also be included in a field survey. (A full version of a coping mechanism table is included in Annex 1).

This information can then be used to understand how climate risks threaten the agricultural value chain and also identify potential interventions that might mitigate these climate risks. Areas where coping strategies either do not exist or are inadequate, are obvious areas to look at more closely as potential areas of intervention in the value chain.

Table 9: Assessing potentially climate resilient activities used by farmers

Climate resilient practices adopted:	1. Use of organic fertilizer/manure	2. In-situ incorporation of crop residue	3. Mulching
	4. Use of varieties that mitigate local climate risks (e.g. drought tolerant or flood resistant)	5. Change/adjustment of sowing/planting time	6. Intercropping
	7. Soil conservation practices	8.Rain water harvesting	9. Water conservation practices
	10. Irrigation Soil conservation	11. Zero tillage	12. Other (specify).

Note: This is not intended to be a comprehensive list of climate resilient practices and should be adapted to suit local conditions, using local and expert knowledge.

Table 10: An example of assessing coping mechanisms across a value chain when there are increased wet spells

Climate risk	Stage	Impact	Coping mechanism
Wet spell	Pre-Production	Decay of seeds/saplings planted	No coping mechanism
	Production	Destruction of cotton flower due to untimely rainfall	Shifting planting period
	Post-harvest/ storage	Destruction of cotton and cotton seeds due to moisture	No adequate storage for coping
	Marketing		

x. Synthesizing findings: identifying bottlenecks and opportunities

This section discusses way to synthesize the information that has been gathered about an agricultural value chain and draw up a set of prioritised recommendations.

By following these steps, you will be able to:
Provide a summary of key bottlenecks and opportunities along a value chain;
Prioritise way to address bottlenecks / take advantage of opportunities

Once the basic information of the value chain has been gathered, it is possible to move to evaluate the findings. It is important to identify recommendations that are both practical and will have a clear impact on the function of the value chain. Recommendations that require large amounts of capacity development in a short time, or expensive technology, or are politically contentious are unlikely to be taken up.

Starting points for analysis are:

- Assessing the reasons for, and implications of, differing market power of the key value chain actors
- Identifying gaps – for example: Are services missing? Who could provide the missing services?
- Identifying practical ways to support change– for example: Who is an ally, neutral or a blocker? Options or tactics to maximize incentives and enable change? Are additional partners needed to address challenges?

Once this basic analytical overview is completed, it is possible to identify the key leverage points and understand the options and opportunities for change. Then these can be filtered - for example, to identify those that are within reach of the weakest actors, are likely to add significant value, are likely to address a significant blockage or improve value chain processes in the shortest time.

Ideas for change often come from informants initially – these can then be shared and discussed with other value chain actors during the field work. This initial filtering of locally-generated ideas for change provide a useful starting point for developing final recommendations.

The information that has been collected provides the basis to measure the performance, constraints and prospects for change along an existing value chain. The combination of mapping, activity and value analysis make it possible to assess the efficiency and sustainability of the value chain and the degree of coordination and synergy among the actors and processes.

The analysis also focuses on bottlenecks that are identified along the chain along with unexploited opportunities and forms the bases for making a set of recommendations to address bottlenecks and improve efficiencies along the value chain.

The key results/outcomes of the analysis can initially be collated using a simple matrix, such as shown in **Table 11,** which is taken from an analysis of the Arhar Dal (a lentil) value chain in Odisha. In this case, recommendations for enhancing the value chain can be built around addressing the major constraints and exploiting the main opportunities that have been identified. In the case of Arhar, the recommendations are shown in **Figure 18**, below.

Table 11: An example of a simple matrix summarising findings

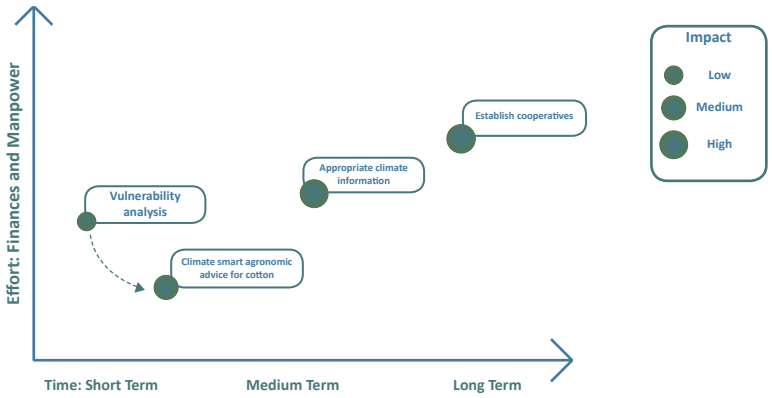
Stage of the Value chain	Bottlenecks	Opportunities
Pre-production	• Inadequate availability of short-duration, climate resilient high yielding varieties	• Advocacy to focus research on climate resilient varieties
Production	• Low awareness among farmers on climate resilient practices • Low adoption of intercropping	• Scope for extension of area under Arhar • Favourable Govt. policy and programme for pulse cultivation
Processing/Storage	• Inadequate processing facilities	
Marketing	• Low level of knowledge on up-date market information • Exploitation by middle men	• Regular demand for Arhar Dal by household consumers as well as institutional buyers • Scope to export Arhar (raw and processed) to neighbouring states

Often the result is a large number of potential activities or reforms. To be useful for policy makers, these need to be prioritised in some way. The ACT programme has used a simple two-by-two matrix ranking that incorporates impact (low to high) and time taken to show impacts (short-term to longer-term). This provides a first-cut of priorities for policy and implementation.

However, this list of recommendations needs to be further refined to take account of both political priorities and the resources available. At this stage, it is important to present the VCA findings and initial recommendations at a workshop with clients (in ACT's case, this is usually Agriculture Departments). This provides the opportunity to refine the list of recommendations in terms of the available financial and human resources along with, importantly, political priorities.

ACT has used three broad criteria to prioritise recommendations for action: (i) Time (whether impacts can be achieved over the short-, medium- and longer-term); (ii) Effort (a combination of the manpower and finance required); and (iii) Likely impacts (from high to low). The schema below (Figure 13 illustrates the prioritisation used in this report.

Figure 13: Example of a prioritisation schema



Source: Climate Resilient Agriculture in Bangladesh through Value Chain Analysis of Cotton, ACT 2019

In this example, there is a sequencing issue associated with prioritisation. The climate vulnerability analysis has to be undertaken first, to provide the evidence required to produce 'climate smart' agronomic advice, relevant at sub-regional level, for cotton farmers (i.e. updating existing agronomic advice on cotton cultivation, to include ways to respond effectively to changes in weather and climate).

Table 12 shows the final, prioritised recommendations for Arhar Dal in Odisha which were presented to the state Agriculture Department. Arhar had been identified for study as a potentially climate resilient crop in certain districts in Odisha, so in the case the objective was to look at ways that increased both productivity and the area under cultivation. Recommendations were prioritised as 'high' and 'medium'.

Initially in this case, there were additional 'draft' recommendations. In a similar way to the Bangladesh example above, the prioritisation process factored in costs, the capacity to deliver and support change, the time required to obtain sizeable benefits and the incentives to change. When some of these initial recommendations were ranked as 'low' in the prioritisation exercise, they were dropped from the final recommendations presented to the state Agriculture Department.

Table 12: Recommendations to improve and strengthen the Arhar Value chain in Odisha

Recommendation	Rank
Promote short duration & high yielding climate resilient varieties of Arhar such as: UPAS-120, Manak, Asha, Paras, DLR-1, BRG-2	High
Promote Integrated nutrient management practices in Arhar to maintain soil fertility and enhance productivity by optimizing the benefits of plant nutrients from organic, inorganic and biological sources	High
Promote intercropping and bund planting to spread risk on across a wider range of crops, increase and stagger income flows, and use available land more productively (intercropping with finger millet/green gram/black gram/radish/lady finger)	Medium
Establish aggregation and pack house facilities at cluster level to reduce of waste and transport losses, and enhance marketability and obtain a higher better price for Arhar	High
Provide storage facilities for Arhar, to reduction post-harvest losses and minimize distress sales	High
Establish dal processing units at cluster level to reduce post-harvest losses, add value, extend shelf-life, enhance marketability and obtain a better price for processed Arhar	High
Develop market linkages for market assurance, obtaining better prices and minimizing distress sales of Arhar	High
Promote and strengthen of Farmer Producer Organizations (FPOs) as a way to further develop the Arhar value chain	High

Source: ACT, (2018). Operational Strategy for Climate Resilient Value Chain Development of Mango & Arhar in Odisha.

BOX 6

MAINSTREAMING RECOMMENDATIONS IN ODISHA

In Odisha, ACT studied the value chains of Mango and Arhar (Pigeon peas). During this process there was consistent interaction with the agriculture department and the findings recommendations were also shared with other key stakeholders such as agricultural universities and training centres NGOs and major agricultural projects in the state.

This has resulted in the study's recommendations for Mango cultivation are now included in the state Agriculture Department's 2019 Kharif Plan, In addition, the findings on both mango and Arhar value chains has been incorporated into the Odisha Integrated Irrigation Project, financed by the World Bank.

Planning next steps

Once recommendations have been finalised, the final step of the value chain work is to hold a workshop where key individuals who would be responsible for taking forward any recommendation can hear, discuss and validate the recommendations. In ACT's case these workshops include senior officials from Agriculture and other relevant government departments, academics from the state agricultural university, relevant state training institutions and representatives of key NGOs working in the agricultural sector.

A major outcome of workshops that present and reflect on the findings of a VCA exercise is not just that information and lessons have been shared, but that 'next steps' are mapped out along with clearly identified leadership to take each step forward.

The analysis of value chains of climate resilient crops, as described here, is not an end in itself. It just provides an evidence base for further interventions and support.

Frequently, the findings of a VCA exercise will be inadequate to define the detail of any policy or implementation reforms without some further work. For example, when a particular bottleneck is identified, there may still be inadequate information available about how best tackle it, or insufficient understanding of the cause of the bottleneck. In these situations, further work will be required to put together adequate information that can underpin any plans to address the identified constraint(s).

BOX 7

SCALING UP CLIMATE RESILIENT VALUE CHAINS IN MAHARASHTRA

The agriculture sector in Maharashtra is highly vulnerable as the state experiences frequent extreme events such as droughts and rainstorms which will be further exacerbated by climate change.

In this context, ACT conducted a multi-criteria analysis to identify crops that will be able to withstand the impacts of climate change. The study identified sorghum, pearl millet, pigeon pea, chickpea, and soybean as the most appropriate climate resilient crops, as they are water and energy efficient, deliver better economic returns, and are more tolerant to variations in temperature, rainfall, and extreme events. Based on the findings, the World's Bank's project on Climate Resilient Agriculture (PoCRA) in Maharashtra has included four of these five crops in the list of crops that it will support in the state.

The ACT team followed the value chain of these crops, interviewing over 300 key actors in Maharashtra, including producers and producer organisations, traders, processors, distributors and retailers, universities and research institutes, extension service providers and financial institutions.

The analysis showed that a major constraint on promoting the expansion of climate silent cropping patterns was the weak capacity of farmer producer companies (FPCs) - especially their lack of working capital. In addition, there were limited options for FPCs to access loans, except at very high interest rates.

ACT then initiated follow-on work to support FPCs build their capacity and develop viable business plans. In parallel, ACT developed an FPC assessment tool that banks and other finance providers can use to identify and rate the capacity needs of individual FPCs. This opens up opportunities for FPCs to access finance at more favourable interest rates, and also route appropriate capacity development support to the FPCs.

ANNEX

Annex 1: Formats for gathering field-level information across the agricultural value chain

This Annex has a set of indicative detailed questions for individual interviews and focused group discussions with all relevant stakeholders across a crop's value chain. In the main document there are illustrative tables that broadly summarise the structure and logical flow of these questions. They outline the various pertinent questions which need to be asked to map a crop's value chain.

This annex provides a detailed version of these tables which demonstrate how each of those factors can be captured through various field methods. The list of stakeholders mentioned here is not exhaustive but broadly representative of different agricultural value chain players.

These tables are based on those used in Bangladesh for field work on cotton production. However, they are sufficiently generic to be used, with small changes to suit another context, to gather information on any crop.

These examples cannot cover every factor that may be relevant and will need to be adapted and amended to suit another location.

A. Interview with individual farmers

This set of questions was used to capture information through interviews with individual cotton farmers in Bangladesh. These questions map value chains of cotton and the other crops in the cotton bundle. Based on a piloting survey it was found that cotton farmers in Bangladesh do not have any role to play in the value chain beyond the production level. Lack of infrastructure facilities and market information was a common factor across locations and therefore these questions have been explored in detail through Focus Group Discussions (Part B of this Annex) rather than in discussion with individual farmers. These questions have thus been omitted from the questions on the cotton value chain but have been explored for the other crop value chains.

Household information

<table>
<tr><td>District:</td><td colspan="3"></td><td>Sub- district:</td><td colspan="3"></td></tr>
<tr><td>Union Council</td><td colspan="3"></td><td>Village:</td><td colspan="3"></td></tr>
<tr><td>Respondent's Name:</td><td colspan="3"></td><td>Name of HoH:</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Gender:</td><td colspan="2" rowspan="2">Male</td><td rowspan="2">Female</td><td rowspan="2">Religion</td><td>1. Muslim</td><td colspan="2">2. Hindu</td></tr>
<tr><td>3. Buddhist</td><td colspan="2">4.Other_____</td></tr>
<tr><td>Education</td><td>1. Primary</td><td>2. Secondary</td><td colspan="2">3.High School/ Inter</td><td>4. Graduate/ above</td><td>5. Technical/ Trade</td><td>6. Other</td></tr>
<tr><td rowspan="2">Agricultural Land Holding owned: (in Acres.)</td><td colspan="2">Irrigated</td><td colspan="2">Non-Irrigated</td><td colspan="2">Fallow</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td>Leased in land (in Acres)</td><td colspan="3"></td><td colspan="3">Leased in rent per acre</td><td></td></tr>
</table>

Cropping pattern

Crops	Current (Acres)	Season (months)	10 years ago (Acres)	Season (months)
Crop 1: Cotton				
Crop 2: _____				
Crop 3:_____				
Crop 4: _____				
Crop 5: _____				
Crop 6				
Crop 7				
Crop 8				

Cotton Value Chain

Pre-production and production

Variety		Crop Area (rows sown)	
Owned or Leased		Area irrigated	
Source of irrigation			

Cotton crop bundle:

Crops	Current (Acres)	Season (months)
Crop 1: Cotton		
crop 2: _____		
crop 3:_____		
crop 4: _____		

Details of activities:

Description	Quantity of own inputs used		Hired inputs used (Total)		Unit	Unit rate (/unit)		Total payments ()
Labour demand	F	M	F	M	Days	F	M	
Land preparation					"			
Sowing / transplanting					"			
Irrigation					"			
Fertilizer and manure application					"			
Weeding					"			
Application of pesticides etc					"			
Harvesting					"			
Threshing					"			
Bullocks					Days			
Tractors					Hrs			

Seed			Kg		
Fertilizers			Kg		
Farmyard manure			QT		
Chemical Fertilisers			Kg		
DAP			"		
Urea			"		
Complex fertilizers _____			"		
Micronutrients_____			"		
Weedicide			Lts		
Pesticides (with seed treatment)			Lts,		
			"		
Irrigation cost					
Number of days of irrigation X Hours of irrigation per day			Hrs		
Horse Power of Pump set:			HP		
Electricity cost					
Diesel (for operating pump)			Lts		
Hired water (from neighbour's tubewell)			Lts		
Storage					
Output (Production)	Quantity			Price per unit (as earned by farmer)	
Yield in normal years (avg. past years)			Qts		
Total Production- (current year)			Qts		
By Product			Qts		

Information and credit facilities

Access to credit:	1. Krishi Bank	2. Savings Group	3. Bank	4. Micro finance institutes (MFI)
	5. Money lender	6. CDB	7. Others (specify)	7.None

Access to information/ service:	1. Neighbouring farmers	2. Extension services/ CDB	3. Market/ Input Retailers	4. Company representatives	5. Media	6. Others (specify)

Infrastructure facility:	Availability		Place	Distance from farm (Km)	Accessibility		Remarks/ comments
Storage: (Cold storage/ Godown)	Yes	No			Yes	No	
Processing:	Yes	No			Yes	No	
Market:	Yes	No			Yes	No	

Market channels for selling produce

Place of sale:	A. Immediate sale			B. Store & sale		
	Selling price(/Qtls)	Quantity Sold	Time gap in price realization (days)	Selling price (/ Qtls)	Quantity Sold	Time gap in price realization (days)
Farm Gate/Door step						
Village Hat						
Whole sale Market						
Contract/Tied sale						
Processing Unit						
Nearby Town/City Market						
Outside District						
Outside Division						

Price satisfaction level:	1.High		2.Medium		3.Low		4. Distress sale				
Mode of Payment:	1. Cash		2.Cheque		3.On line transfer		4.Credit		5.Other(specify)		
Participation of women in the value chain (Decision making -DM and Activities -A):	1.Production activities		2. Harvest		3. Post-harvest operation		4.Marketing & sales		5.Other		6.None
	DM-	A-	DM-	A-	DM-	A-	DM-	A-	DM-	A-	
Role of women Savings Groups in the value chain:											

Climate risks and coping mechanisms

Climate resilient practices adopted:		1. Use of manure	2. In-situ incorporation of crop residue		3. Mulching
	4. Use of tolerant/resistant variety		5. Change/adjustment of sowing/planting time	6. Intercrop-ping	
	7. Use of organic pesticides		8.Rain water harvesting	9. Water conservation	
	10. Soil conservation		11. Custom hiring	12. Oth-er(specify)	

Climate risk, impact & coping mechanism:			
Stage	Climate Risk	Impact	Coping mechanism
Pre-production	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
Production	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Storage	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		

Processing	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Marketing	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		

Constraints and Suggestions		
Stage	constraints	suggestions
Pre-production		
Production		
Storage		
Processing		
Marketing		

Value chain constraints

Suggestions for improvement across the value chain

Are you satisfied with the present situation regarding:	Yes / No	Suggestions for improvement
Seed availability		
Seed quality		
Seed variety		
Fertilizer availability		
Pesticides		
Labour availability		
Climate information		
Agro-advisories		
Market channels (through traders)		
Weight measurement procedure followed		
Price received		
Mode of payment		
Market information (awareness about price at the mandi)		
Credit facilities		
Crop insurance		
Storage facilities		
Transportation facilities		

Crop 2 value chain

Pre-production and production

Variety		Crop Area (rows sown)	
Owned or Leased		Area irrigated	
Source of irrigation			

Description	Quantity of own inputs used		Hired inputs used (Total)		Unit	Unit rate (/unit)		Total payments ()
Labour demand	F	M	F	M	Days	F	M	
Land preparation					"			
Sowing / transplanting					"			
Irrigation					"			
Fertilizer and manure application					"			
Weeding					"			
Application of pesticides etc					"			
Harvesting					"			
Threshing					"			
Bullocks					Days			
Tractors					Hrs			
Seed					Kg			
Fertilizers					Kg			
Farmyard manure					QT			
Chemical Fertilisers					Kg			
DAP					"			
Urea					"			
Complex fertilizers _____					"			
Micronutrients_____					"			
Weedicide					Lts			
Pesticides (with seed treatment)					Lts,			
Irrigation cost								
Number of days of irrigation X Hours of irrigation per day					Hrs			
Horse Power of Pump set:					HP			
Electricity cost								
Diesel (for operating pump)					Lts			
Hired water (from neighbour's tubewell)					Lts			
Storage								
Output (Production)	Quantity					Price per unit (as earned by farmer)		
Yield in normal years (avg. past years)					Qts			
Total Production (current year)					Qts			
By Product (fodder, straw)					Qts			

Information, credit and infrastructure facilities

Access to credit:	1. Krishi Bank		2. Savings Group		3. Bank			4. Micro finance institutes (MFI)				
	5. Money lender		6. Other (specify)					7.None				
Access to information/ service:	1. Neighbouring farmers		2. Extension services		3. Market/ Input Retailers		4. Company representatives		5. Media		6. Others (specify)	
Infrastructure facility:	Availability		Place		Distance(Km)		Accessibility		Remarks/ comments			
Storage:(Cold storage/ Godown)	Yes	No					Yes	No				
Processing:	Yes	No					Yes	No				
Market:	Yes	No					Yes	No				

Marketing facilities

Place of sale:	A. Immediate sale			B. Store & sale		
	Selling price(/Qtls)	Quantity Sold	Time gap in price realization (days)	Selling price (/ Qtls)	Quantity Sold	Time gap in price realization (days)
Farm Gate/Door step						
Village Hat/Mandi						
Whole sale Market						
Contract/Tied sale						
Processing Unit						
Nearby Town/City Market						
Outside District						
Outside Division						

Price satisfaction level:	1.High		2.Medium		3.Low		4. Distress sale					
Mode of transport:	1.Own		2.Public		3.Pvt.		4.Customer responsibility					
Mode of Payment:	1. Cash		2.Cheque		3.On line transfer	4.Credit	5.Other(specify)					
Price build up at different level of supply chain:	Existing Supply Chain								% of produce		Place (a- with in dist/b- outside dist/c- outside division)	
	1. Farmer Consumer											
	2. Farmer Wholesaler Retailer Consumer											
	3.Farmer Trader Wholesaler Retailer Consumer											
	4.Farmer Processor Wholesaler Retailer Consumer											
	5.Farmer Local Aggregator Trader Wholesaler Retailer Consumer											
Participation of women in the value chain (Decision Making- DM, Activities- A):	1.Production activities		2. Harvest		3. Post-harvest operation		4.Marketing & sales		5.Other		6.None	
	DM-	A-	DM-	A-	DM-	A-	DM-	A-	DM-	A-		
Role of Women Savings Groups in the value chain:												

Climate risks and coping mechanisms

Climate resilient practices adopted:		1. Use of manure	2. In-situ incorporation of crop residue	3. Mulching
	4. Use of tolerant/ resistant variety	5. Change/adjustment of sowing/planting time	6. Intercropping	
	7. Use of organic pesticides	8.Rain water harvesting	9. Water conservation	
	10. Soil conservation	11. Custom hiring	12. Other(specify)	

Climate risk, impact & coping mechanism:

Stage	Climate Risk	Impact	Coping mechanism
Pre-production	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Production	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Storage	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Processing	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		

Marketing	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		

Value chain constraints and suggestions

Constraints and Suggestions		
Stage	Constraints	Suggestions
Pre-production		
Production		
Storage		
Processing		
Marketing		

Are you satisfied with the present situation regarding:	Yes / No	Suggestions for improvement
Seed availability		
Seed quality		
Seed variety		
Fertilizer availability		
Pesticides		
Labour availability		
Climate information		
Agro-advisories		
Market channels (through traders)		
Weight measurement procedure followed		
Price received		
Mode of payment		
Market information (awareness about price at the mandi)		
Credit facilities		
Crop insurance		
Storage facilities		
Transportation facilities		

B. Focus Group Discussions with Farmers (separate with women and men)

District:
Village:
No. of respondents:
Social groups if any:
Agricultural land ownership (acres)/ or labour:

Give us an overview of agricultural activities in your village-

- Crops grown (names, crop cycles and intercropping) and see varieties:
- Allied activities (livestock, processing, etc.):
- Irrigation:
- Fertilizers/manure:
- Soil and water conservation:

What are the different agricultural activities performed by women and men? What are the daily wage rates for these?

Who is the decision maker in your family? Do women have a say in agricultural practices- investments, savings, price allocations, etc.? Do women have a say in household decisions- investments, health, education, occupation, etc.

Are there women's savings groups and farmer groups in your village? Please share the details. (no. of members, composition based on socio-economic groups, activities, savings, linkages with banks, etc.)

Closest market where you sell your produce (for cotton and other crops)

How do you access information on agriculture?

Do you have access to credit? If yes, what type of credit do you access? (details on interest rates, formal or informal, purpose, etc.)

Do you have access to storage facilities? (all crops) If yes, where are they located?

How many farmers grow cotton in your village? Do you think cotton is a viable option in your area? What are the benefits and bottlenecks?

Could you describe the existing supply chains (production- processing- marketing- consumption) for cotton and other crops? How is value added across these (prices) and what is the nature of your participation?

Climate risk, impact & coping mechanism:			
Stage	Climate Risk	Impact	Coping mechanism
Pre-production	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		

Production	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Storage	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Processing	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		
Marketing	Dry spell		
	Wet spell		
	Heat wave		
	Hail storm		
	Early monsoon		
	Late monsoon		
	Drought		
	Flood		
	Storms		

Constraints and Suggestions		
Stage	Constraints	Suggestions
Pre-production		
Production		
Storage		
Processing		
Marketing		

Are you satisfied with the present situation regarding:	Yes / No	Suggestions for improvement
Seed availability		
Seed quality		
Seed variety		
Fertilizer availability		
Pesticides		
Labour availability		
Climate information		
Agro-advisories		
Market channels (through traders)		
Weight measurement procedure followed		
Price received		
Mode of payment		
Market information (awareness about price at the mandi)		
Credit facilities		
Crop insurance		
Storage facilities		
Transportation facilities		

C. Interview with input dealers

Input category:	1.Seed/Planting material	2.Plant nutrients	3.Plant protection material	4. Farm implement/ equipment	5. Other
Name of the enterprise:					
Ownership	1. Govt.	2.Private	3. Cooperative		4. Other
Name of Dealer/ Respondent:					
Address					
District:		7	Division		
Contact number:		9	Email		
Commonly used varieties:					
Seed/Planting material	1.Local				
	2.HYV				
	3.Hybrid				
	4.Graft				
Plant nutrients	1.Inorganic				
	2.Organic				
Plant protection material	1.Inorganic				
	2.Organic				
Farm implement/ equipment	1.Manual operated				
	2.Power driven				
Services provided	1.Only sale	2. Advise on use/ application	3.After sale service		4.Other (specify)
Whether supply is adequate to meet the requirement of the farmers in the locality			1.Yes		2.No (Please mention reason)
Whether required input is supplied in time of need of the farmer			1.Yes		2.No (Please mention reason)

Climate Risk, Impact & Coping mechanism/contingency plan:

Climate Risk	Impact	Coping mechanism/contingency plan
Dry spell		
Wet spell		
Heat wave		
Hail storm		
Late monsoon		
Drought		
Flood		
Storms		
Issues & constraints		
Opportunities		

Suggestions	High impact priority	Low impact priority
Short term		
Long term		

D. Discussion with respondents from processing units

Name of the Unit					
Name of proprietor/ Respondent					
Address					
District			Division		
Contact number			Email		
Production capacity of the unit per day (Qtl)			No. of days the unit functions per year		
Type of processing	1. Manual	2. Machine based	Type of machine	1. Traditional	2. Automated
Use of solar energy	1. Yes		2. No		
	a. Light	b. Power			
Type of product					
Source of procurement	1. Farmer	2. Agents	3. Wholesaler		
	4. Retailer	5. Mandi/Market	6. Other (specify)		
Place of procurement	1.With in district	2. Outside district	3. Outside division	4. Other (specify)	
Service provided to the seller	1. Credit facility	2. Collection from farm gate	3. Transport arrangement		
	4. supply of inputs	5. Other	6. No		
Major buyers/customers	1.Consumer	2. Wholesaler	3. Retailer		
	4. Mall	5.other(specify)			

Supply to high end processor/processing industry	1.Yes			2.No
	Semi processed product	Name of high-end processing unit/industry	Place	
Place of sale (%)	1.Within district	2. Outside district	3. Outside division	4. Outside country
Consumers' preferences				
Factors of Demand	1.Price of the product	2. Taste & preference of buyer	3. Price of related products	4. oth-er(specify)

Production economics	Product 1-	Product 2-	Product 3-
Procurement cost (/Kg)			
Processing cost (/Kg)			
Selling price (/Kg)			
Wastage (%)			
Average volume of pro-duction (Qtl)			
Participation of women in processing			
Role of women savings groups in processing			

Climate Risk, Impact & Coping mechanism/contingency plan:		
Climate Risk	Impact	Coping mechanism/contingency plan
Dry spell		
Wet spell		
Heat wave		
Hail storm		
Late monsoon		
Drought		
Flood		
Storms		
Issues & constraints		
Opportunities		
Suggestions		

E. Discussion with market participants

Name of the Mandi/Market												
Location/Place				Block/NAC/City								
District				Division								
Name of the Respondent												
Designation												
Address												
Contact number			Email									
Transaction details (2016)												
Total Supply (Qtl)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Total Sale (Qtl)												
Average market price (/Qtl)												
Reason of fluctuation in supply/sale/price in diff season:												
Reason of fluctuation in supply:												
Reason of fluctuation in sale:												
Reason of fluctuation in price:												

Source of supply (Place)	1.With in district		2. Outside district		3. Outside division		4. Other	
	Place	%	Place	%	Place	%	Place	%

Major Suppliers (%)	1. Farmer	2. Traders/ Agents	3. Wholesaler	4. Other(specify)

Major buyers/ customers (%)	1.With in district	2. Outside district	3. Outside divsion	4. Outside country

Average procurement cost (/Qtl)		Average selling price (Rs/Qtl))		Wastage%	

Procurement norm				
Facilities available				
Market Determinant factors	1. Factors of Demand	Ranking	2. Factors of Supply	Ranking
	1.1 Price of the product		2.1 Demand of the product	
	1.2 Taste & preference of buyer		2.2 Price of the product	
	1.3 Price of related products		2.3 Cost of production	
	1.4 supply /availability of the product		2.4 No. of producers/volume of production	
Impact of climate change				
On demand	1. Increase	2. Decrease	3. No change	4.
On supply	1. Increase	2. Decrease	3. No change	4.
On quality	1. Increase	2. Decrease	3. No change	4.
On price	1. Increase	2. Decrease	3. No change	4.
On weight	1. Increase	2. Decrease	3. No change	4.
On business transaction	1. Increase	2. Decrease	3. No change	4.
Issues & constraints				
Opportunities				
Suggestions	High impact priority		Low impact priority	
Short term				
Long term				

F. Interview with trader/wholesaler

Name				
Address				
District		Division		
Contact number		Email		
Type of business	1. Wholesaler	2. Retailer	3. Commission Agent	4. Other(specify)
No. of years in this business		Business engagement	1. Seasonal	2. Throughout the year
In case of seasonal business, what is his engagement in lean/off season				
Source of procurement	1. Farmer	2. Agents	3. Wholesaler	
	4. Retailer	5. Mandi/Market	6. Other(specify)	
Place of procurement	1.Within district	2. Outside district	3. Outside division	4. Other (specify)
Terms & condition for procurement				
Service provided to the seller	1. Credit facility	2. Collection from farm gate	3. Transport arrangement	
	4. supply of inputs	5. Information	6. Other	7. No
Major buyers/customers	1.Consumer	2. Wholesaler	3. Retailer	4. Processor	5. Other
Place of sale	1.Within district	2. Outside district	3. Outside division	4. Other (specify)
Consumers' preferences				

Transaction details	During harvest	1-3 month after harvest	4-6 month after harvest
Average volume of transaction (Qtl)			
Average procurement cost (/Qtl)			
Average selling price (/Qtl)			
Wastage (%)			
Reason for fluctuation of price & volume			

Factors of Demand	1.Price of the product	2. Taste & preference of buyer	3. Price of related products	4. other

Price build up at different level of supply chain:	Existing Supply Chain	% of produce	Place (a- within dist/b- outside dist/c- outside division)
	1. Farmer Consumer		
	2. Farmer Wholesaler Retailer Consumer		
	3.Farmer Trader Wholesaler Retailer Consumer		
	4.Farmer Processor Wholesaler Retailer Consumer		
	5.Farmer Local aggregator Trader Wholesaler Retailer Consumer		

Climate Risk, Impact & Coping mechanism/contingency plan:	
Climate Risk Impact	Coping mechanism/contingency plan
Dry spell	
Wet spell	
Heat wave	
Hail storm	
Late monsoon	
Drought	
Flood	
Storms	
Issues & constraints	
Opportunities	

Annex 2: Multi Criteria Analysis for Selection of Climate Resilient Crops

This section lists out the criteria and sub-criteria chosen for selecting climate resilient crops in Punjab, Pakistan and the rationale for assigning ranks against each for ung bean. The crop has been given a score between 1(lowest)- 4(highest) against each sub-criterion and weighted average calculated based on percentage priority given to each. The crop scored high and hence the study in Punjab carried out an assessment of the crop's value chain to identify bottlenecks and opportunities for overcoming them. Mung bean was one of the 11 crops across the summer and winter cropping seasons which were scored as an outcome of which value chain analyses of three crops- canola, chickpea and mung bean, were carried out.

Criteria	Sub Criteria	Description	Score and Weighted Average
Crop Production Factors (20%)	Input Use Efficiency (10%)	i. Water Requirement: Mung bean water requirement is very low in comparison with other 'kharif' crops, with 325 mm (score 04). ii. Nutrients Requirements: Punjab Agriculture Department recommends one DAP per acre for mung crop, which is considered low (score 04).	Total Score=8 Wgt Average=0.8
	Management Practices (10%)	iii. Labour Requirement and Crop Care: Mung bean is considered hardy crop, and does not require much care. In comparison with other 'kharif' crops, its labour requirement is low (score 04). iv. Tillage Requirement: It does not require deep ploughing and good preparation of soil (score 04). v. Crop Duration: With 110 days, mung bean is considered short duration crop (score 04).	Total Score=12 Wgt Average=1.2
Economic Return (20%)	Economic Return (20%)	i. Profitability: Profitability of mung bean is poor due to low per acre yield. A farmer can earn only Rs. 11,848 from an acre of mung bean (score 01). ii. Marketability and Credit Facility: Mung bean is not one of the major crops in Punjab. However, in large grain markets, mung buyers / traders are common, whereas in small towns where smallholders sell their agriculture produce, buyers are very limited who can offer competitive price (score 02).	Total Score=3 Wgt Average=0.6

Crop Resilience and Environmental Impact of Crop (20%)	Crop Resilience and Environmental Impact of Crop (20%)	iii. Temperature Tolerance: Mung bean is affected by hostile environments, especially high temperatures to certain extent. Among different stages, reproductive stage is most sensitive to extremely high temperatures, resulting in loss of flower buds and seed yield (score 03). iv. Salinity Tolerance: Mung bean has a distinct advantage of being short duration and can grow in wide range of soils and environment. However, increased salinity can decrease yield (score 02). v. Waterlogging Tolerance: Water deficit and waterlogging are the key abiotic stresses that restrict growth, development and yield in mung (score 02). vi. Energy Footprint: Tillage, threshing, and processing require less energy. Its energy footprint is, therefore, on lower side (score 03). vii. Nitrogen: Mung crop does not require much nitrogen. Like other legumes, mung fixes atmospheric nitrogen, which not only meets its nitrogen needs but also benefits following crops. With respect to nitrogen, mung is one of the best choices (score 04). viii. Pesticide Use: Application of pesticide and weedicide is relatively low (score 03).	Total Score=17 Wgt Average=3.4
National Considerations (40%)	Socio Economic (5%)	i. Food Security: Mung bean is a source of protein and usually poor people who can't afford meat rely on mung to meet their dietary requirements (score 03).	Total score=3 Wgt Average=0.15
	Export Potential/ Import Substitution (20%)	ii. Export Potential / Import Substitution Potential: Pakistan is importing mung to the tune of US$ 4 million. Import value is almost insignificant (score 01).	Total Score=1 Wgt Average=0.2
	Self-Efficiency Index (15 %)	iii. Self Sufficiency Index: Demand in country is already being fulfilled by local production with slight deficiency, which is being bridged by import (score 02).	Total Score=2 Wgt Average=0.3
Total Score			6.65

Annex 3: Multi Criteria Analysis for selection of Climate Vulnerable Agro-climatic Zones

This section demonstrates the use of multi-criteria analysis to identify the most vulnerable climate vulnerable agro-climatic zones in Assam- Lower Brahmaputra Valley Zone (LBVZ), North Bank Plain Zone (NBPZ), Upper Brahmaputra Valley Zone (UBVZ), Central Brahmaputra Valley Zone (CBVZ), Hill Zone (HZ) and Barak Valley Zone (BVZ). In different locations, areas were demarcated based on different priorities/situations. For examples, while in Assam agro-climatic zones were assessed, in Punjab, Pakistan, the multi-criteria analysis for area selection was carried out across districts.

In Assam, the five major criteria used in selection included:

- Climatic context of the Agro-climatic Zones with weighted average of 30%
- Social base of the Agro-climatic Zones with 20% weightage
- Agricultural status of the Agro-climatic Zones with 20% weightage
- Status of market information with 15% weightage
- Other considerations including Government preference with 15% weightage

Based on the analysis Hilly zone Lower Brahmaputra Valley Zone, North Bank Plain Zone and Lower Brahmaputra Valley Zone were prioritized for value chain analysis

Criteria	Score for sub criteria	Sub criteria	W	LBVZ		NBPZ		UBVZ		CBVZ		HZ		BVZ	
Climatic (30)	4: Nil 3 :< 5 years 2: 5 – 10 years 1: > 10 Years	Availability of quality weather information for 30 years	4	1	4	1	4	1	4	1	4	1	4	1	4
	4: Very high 3 : High 2: Medium 1: Low	Exposure to extreme rainfall events (Floods / droughts)	9	3	27	3	27	2	18	3	18	3	27	1	9
	4: Very high 3: High 2: Medium 1: Low	Exposure to extreme temperature conditions (Hot / cold)	5	4	20	4	20	3	15	3	15	2	10	1	5
	4: < 4 months 3: 4 – 7 months 2: 8 – 10 months 1: > 10 months	Water availability for crop production	6	2	12	2	12	2	12	2	12	1	12	2	12
	4: Very high 3: High 2: moderate 1: minimum	Future climate change impacts	6	3	18	2	12	2	12	2	12	2	12	2	12
Social (20)	4: > 350 3: 300 - 350 2: 251 - 300 1: < 250	Population density (No. of persons / sq. km)	3	4	12	4	12	4	12	4	12	1	4	4	12
	4: >81% 3: 61 – 80% 2: 41 – 60% 1: <40 %	Proportion of small and marginal farmers	6	3	18	3	18	3	18	3	18	3	18	3	18
	4 :< 4 lakhs 3 : 4 – 6 lakhs 2: 6 – 8 lakhs 1: > 8 lakhs	Income / family / Annum	5	4	20	4	20	4	20	4	20	4	20	3	15

Criteria	Score for sub criteria	Sub criteria	W	LBVZ		NBPZ		UBVZ		CBVZ		HZ		BVZ	
	4: Nil 3: Poor 2: Moderate 1: good	Participation of women in farm decision making	3	2	6	2	6	2	6	2	6	2	6	2	6
Status of agricultural sector (20)	4: Decrease 3: No change 2: 0 – 10 % Increase 1: > 10 %Increase	Change in Net sown area in the recent 5 years	3	1	3	1	3	1	3	1	3	3	9	1	3
	4: Decrease 3: No change 2: 0 – 10 % Increase 1: > 10 %Increase	Adoption of high yield variety	5	1	5	1	5	1	5	1	5	3	15	3	15
	4: Decrease 3: No change 2: 0 – 10 % Increase 1: > 10 %Increase	Rainfed crop productivity	5	1	5	1	5	1	5	1	5	3	15	4	20
	4: Decrease 3: No change 2: 0 – 10 % Increase 1: > 10 %Increase	Irrigated crop productivity	4	2	8	2	8	3	12	2	8	2	8	3	12
	4: > 10 %Increase 3: 0 – 10 % Increase 2: No change 1: Decrease	Amount of chemical consumed	3	3	9	3	9	3	9	3	9	3	9	3	9
Status of market infra structure (15)	2: Low 1: High	Road network density	5	1	5	2	10	1	5	2	10	2	10	1	5
	2: Low 1: High	Inland Water Transport	2	2	4	2	4	2	4	2	4	2	4	2	4
	3: Low 2: Adequate 1: High	Access to market yards	4	3	12	3	12	3	12	3	12	3	12	3	12
	3: Low 2: Adequate 1: High	Capacity of storage facilities	4	3	12	3	12	3	12	3	12	3	12	3	12
Other factors (15)	2: High 1: Low	Government preference	10	2	10	2	10	1	5	2	10	2	10	1	5
	1: High 2: Low	Government expenditure on relief measures	5	1	5	1	5	1	5	1	5	1	5	1	5
	Vulnerability score			215		214		194		200		222		195	
	Rank			II		III		VI		IV		I		V	
	ACZ			LBVZ		NBPZ		UBVZ		CBVZ		HZ		BVZ	