

570



AN INITIATIVE OF
THE NETHERLANDS
RED CROSS

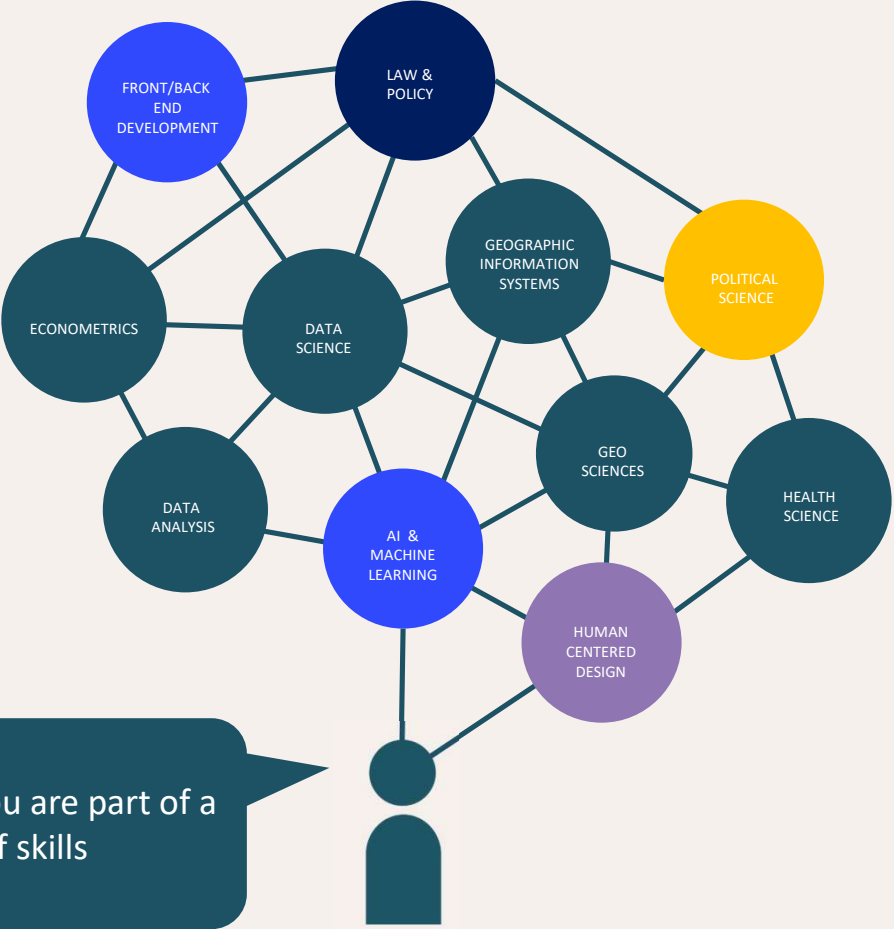
Distribution Algorithm for 121 Cash Based Aid
Maïke Meier
BSc Mathematics



Our purpose is to improve speed, quality & cost-effectiveness of humanitarian aid by using & creating data & digital products.



Our team skills are cross-pollinated



As part of 510 you are part of a larger network of skills

PHASES



510 + AN INITIATIVE OF
THE NETHERLANDS
RED CROSS



What is 121?

121
humanitarian aid



We believe that in the future all people will be digitally connected.



We believe in restoring autonomy to people in need safely.



121

humanitarian aid
safe,



Safe
digital
identities

We believe acting both globally & locally will make humanitarian aid faster.



We believe in the fair distribution of Cash Based Aid.



We believe in the fair distribution of Cash Based Aid.



- Cash or vouchers transfer modality as opposed to in-kind alternatives
- CBA is becoming more prevalent because of its advantages
 - empower persons affected and help them maintain dignity
 - stimulate local market systems and economy
 - be more cost efficient and cost effective

DISTRIBUTION ALGORITHM

WHAT IS THE CURRENT PROGRAM DESIGN PROCESS?

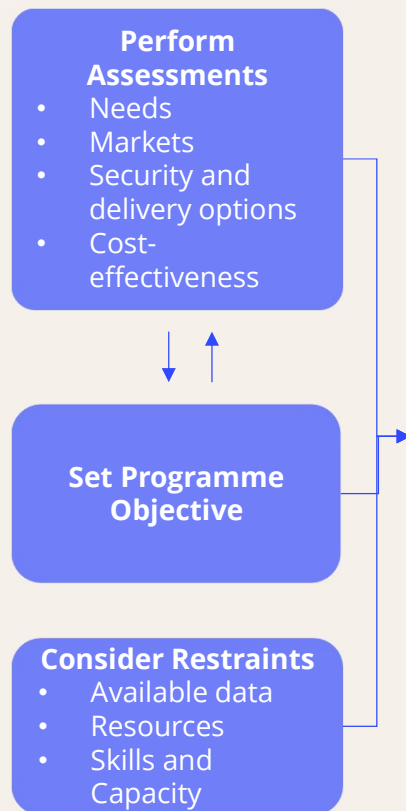
WHAT COULD A DISTRIBUTION ALGORITHM BE?

WHY WE NEED A DISTRIBUTION ALGORITHM

HOW WE RESEARCH A DISTRIBUTION ALGORITHM

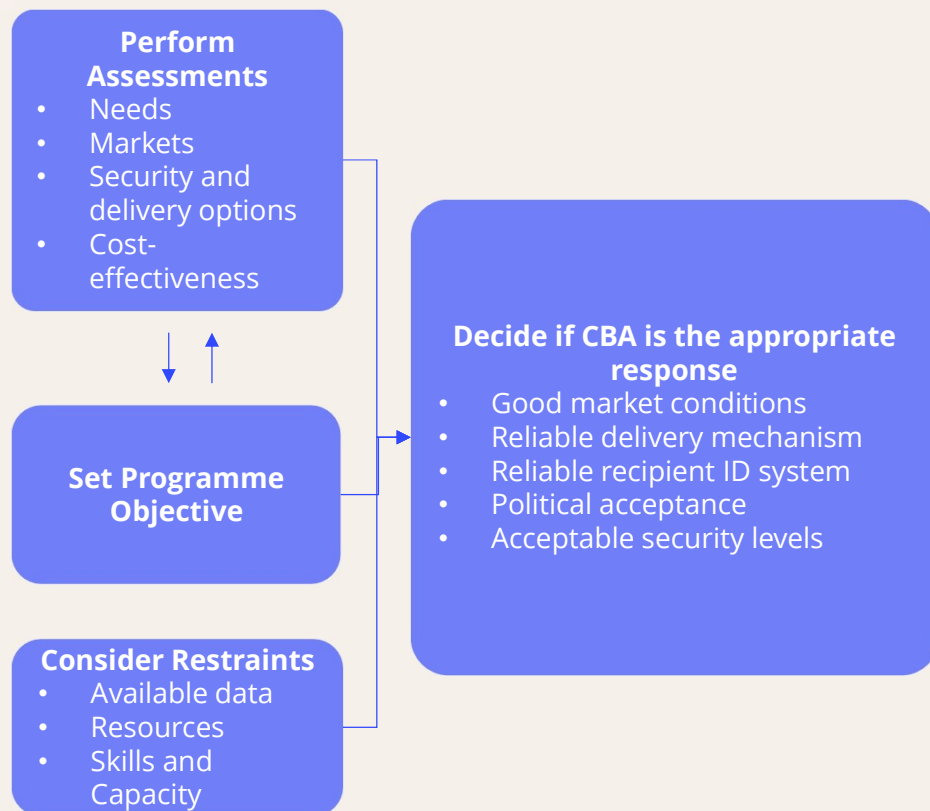
HOW WE DO A DISTRIBUTION ALGORITHM

WHAT IS THE CURRENT PROGRAM DESIGN PROCESS?



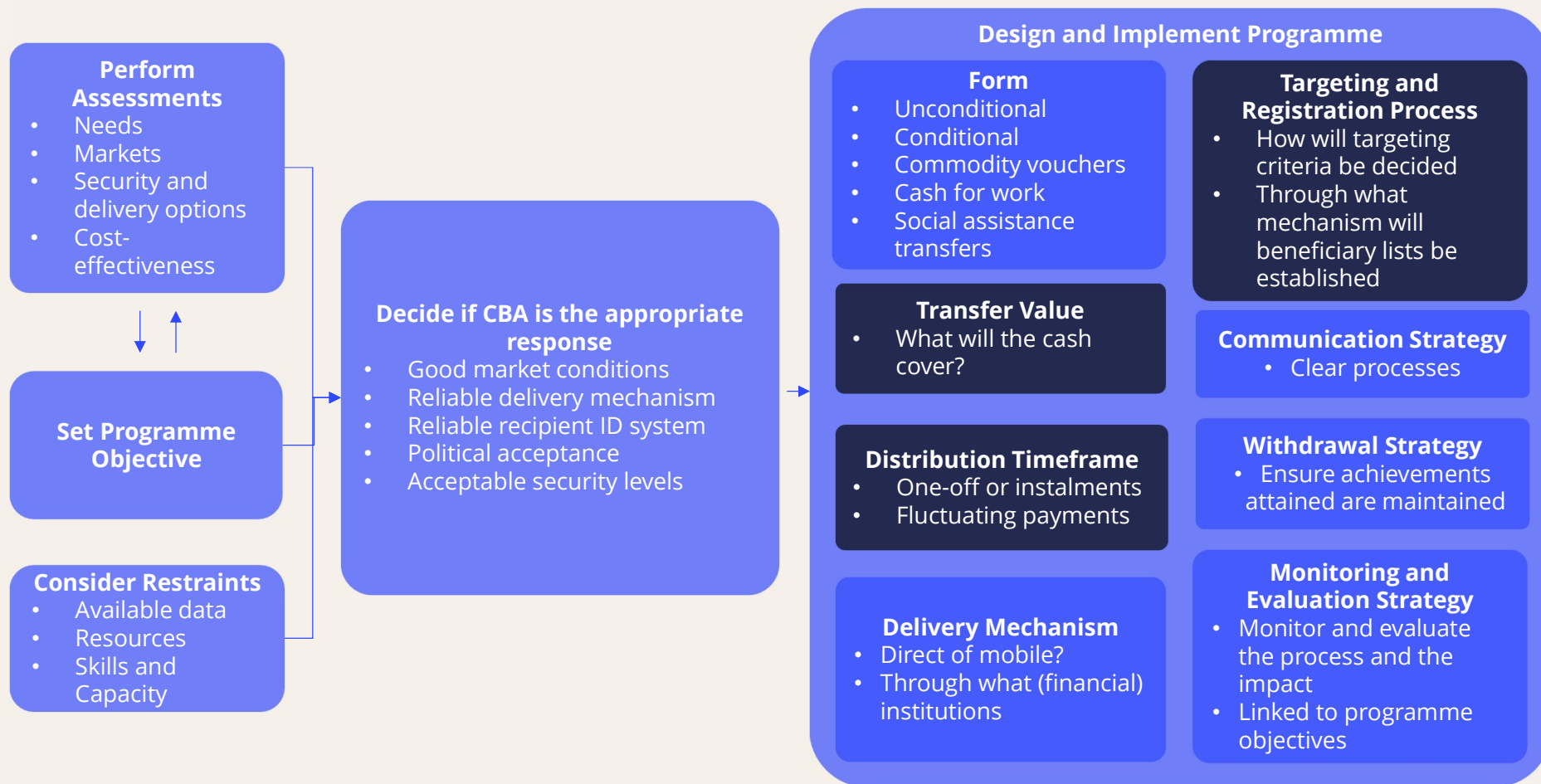
Based on IFRC *Guidelines to cash transfer programming*, 2007

WHAT IS THE CURRENT PROGRAM DESIGN PROCESS?



Based on IFRC *Guidelines to cash transfer programming*, 2007

WHAT IS THE CURRENT PROGRAM DESIGN PROCESS?

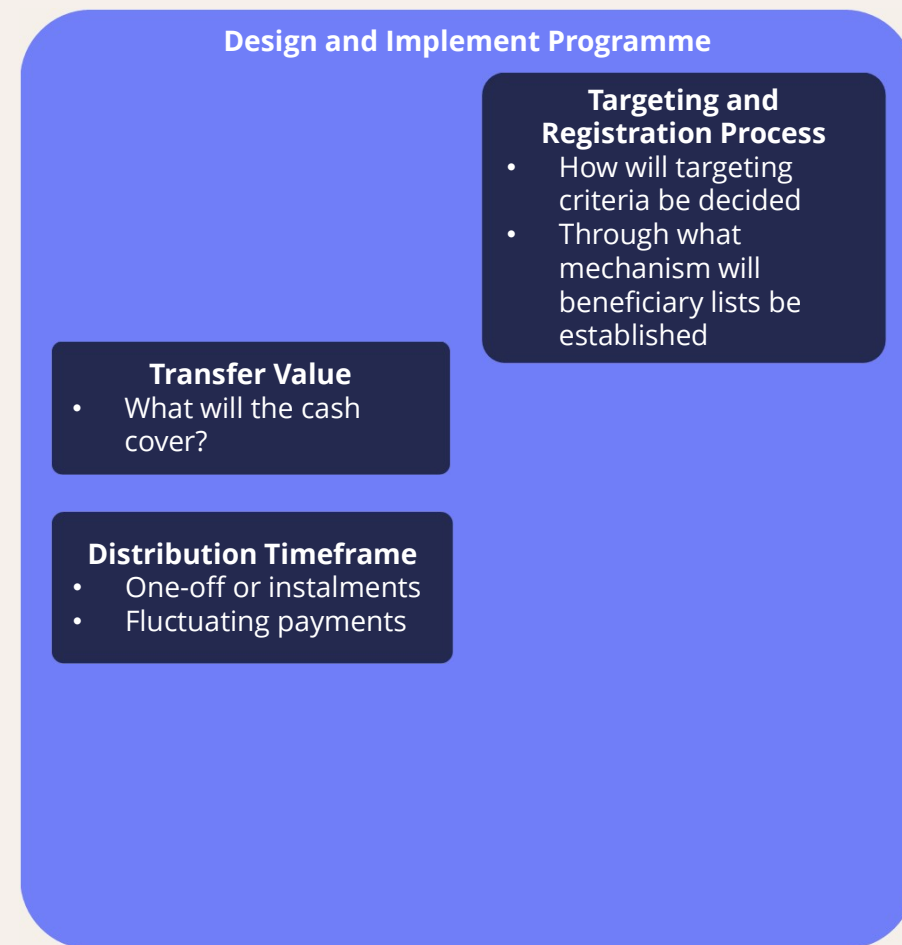


Based on IFRC *Guidelines to cash transfer programming*, 2007

WHAT COULD A DISTRIBUTION ALGORITHM BE?



- An algorithm that takes over these elements of the programme design cycle:
 - WHO: Determines eligibility criteria and identifies eligible households (targeting and registration)
 - HOW MUCH: Sets transfer values for eligible households
 - WHEN: Determines the regularity of the transfers



Based on IFRC *Guidelines to cash transfer programming*, 2007

WHAT COULD A DISTRIBUTION ALGORITHM BE?



Design and Implement Programme

Targeting and Registration Process

- How will targeting criteria be decided
- Through what mechanism will beneficiary lists be established

Based on IFRC *Guidelines to cash transfer programming*, 2007

DISTRIBUTION ALGORITHM

~~WHAT IS THE CURRENT PROGRAM DESIGN PROCESS?~~

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WHY WE NEED A DISTRIBUTION ALGORITHM

HOW WE RESEARCH A DISTRIBUTION ALGORITHM

HOW WE DO A DISTRIBUTION ALGORITHM



We want to help

- We believe in the fair inclusion of vulnerable people
- We believe in the fair distribution of Cash Based Aid

As good as possible

- Fast
- Evidence-based
- Unbiased

Currently, the main limitations in targeting are

- Time and resource heavy
- Unclear (decision-making) processes
 - Targeting criteria are rarely understood
- Not evidence-based

WHY WE NEED A DISTRIBUTION ALGORITHM



		Eligibility criteria are determined by			
Eligible households are identified through	Community actions				
	NGO household visits				

WHY WE NEED A DISTRIBUTION ALGORITHM



		Eligibility criteria are determined by			
		Community identifies			
Eligible households are identified through	Community actions	Time and resource heavy Marginalized groups may be excluded			
	NGO household visits				

WHY WE NEED A DISTRIBUTION ALGORITHM



		Eligibility criteria are determined by			
		Community identifies	Community engagement		
Eligible households are identified through	Community actions	Time and resource heavy Marginalized groups may be excluded	Time and resource heavy		
	NGO household visits		Very time and resource heavy		
		-	-		

WHY WE NEED A DISTRIBUTION ALGORITHM



		Eligibility criteria are determined by			
		Community identifies	Community engagement	NGO	
Eligible households are identified through	Community actions	Time and resource heavy Marginalized groups may be excluded	Time and resource heavy	Time and resource heavy Community may not understand or agree with targeting criteria Process lacks transparency Process lacks accountability	
	NGO household visits		Very time and resource heavy	Very time and resource heavy Miscommunication due to lack of transparency Usually only appropriate in protracted crises	

WHY WE NEED A DISTRIBUTION ALGORITHM



		Eligibility criteria are determined by			
		Community identifies	Community engagement	NGO	Existing structures
Eligible households are identified through	Community actions	Time and resource heavy Marginalized groups may be excluded	Time and resource heavy	Time and resource heavy Community may not understand or agree with targeting criteria Process lacks transparency Process lacks accountability	-
	NGO household visits		Very time and resource heavy	Very time and resource heavy Miscommunication due to lack of transparency Usually only appropriate in protracted crises	-
	Existing structures	-	-	-	Requires trust in structures (and related institutions) May be outdated Not always related to current humanitarian crisis

DISTRIBUTION ALGORITHM

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HOW WE RESEARCH A DISTRIBUTION ALGORITHM

HOW WE DO A DISTRIBUTION ALGORITHM



Based on guidelines, reports and evaluations we designed a targeting framework

- Four conceptual steps
- To lay out a clear decision-making process on which we can build our distribution algorithm
 - Transparent
 - Evidence-based

We assume HO's want to target the most vulnerable persons affected

Targeting framework

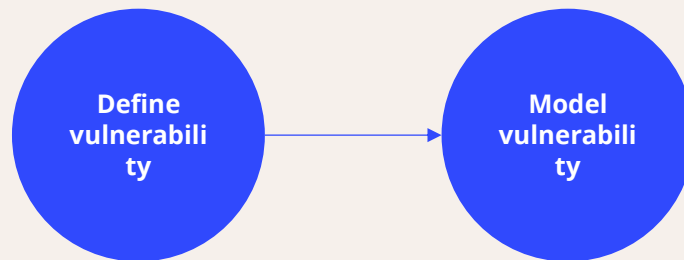


Vulnerability is a complex attribute to measure; it is both dynamic and relative, and depends on programme objectives

1. Define what vulnerability means
2. Find measurable proxies for 'vulnerability' – these are our dependent variables

Absolutely necessary step to make evidence-based decisions regarding targeting

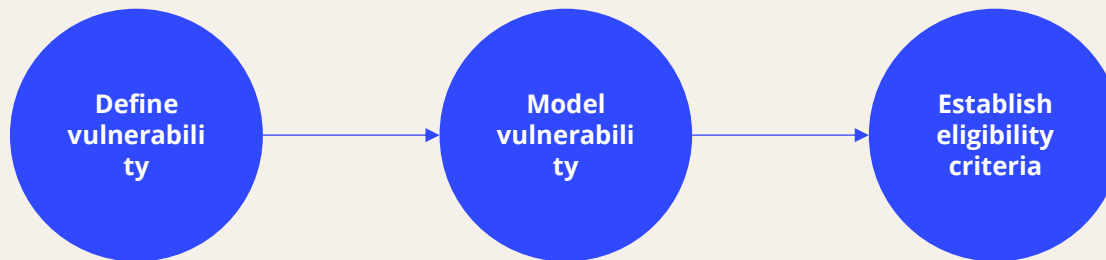
Targeting framework



1. Identify independent variables that could be part of the eligibility criteria
2. Create a model with these independent variables that predict the defined vulnerability (dependent variable)

Crucial link between defining and identifying intended persons affected

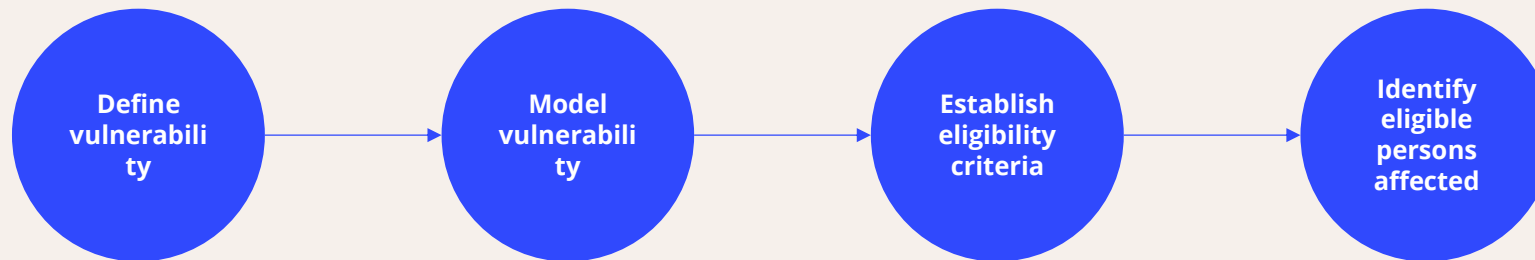
Targeting framework



1. From our model, we know what independent variables are important indicators for vulnerability (dependent variable)
2. Transform the knowledge from the model to eligibility criteria
 - The criteria should be clear and understandable

The criteria are now evidence-based!

Targeting framework



1. Communicate the eligibility criteria to persons affected
2. PA's can apply for the programme and answer questions to check if they meet the eligibility criteria

DISTRIBUTION ALGORITHM

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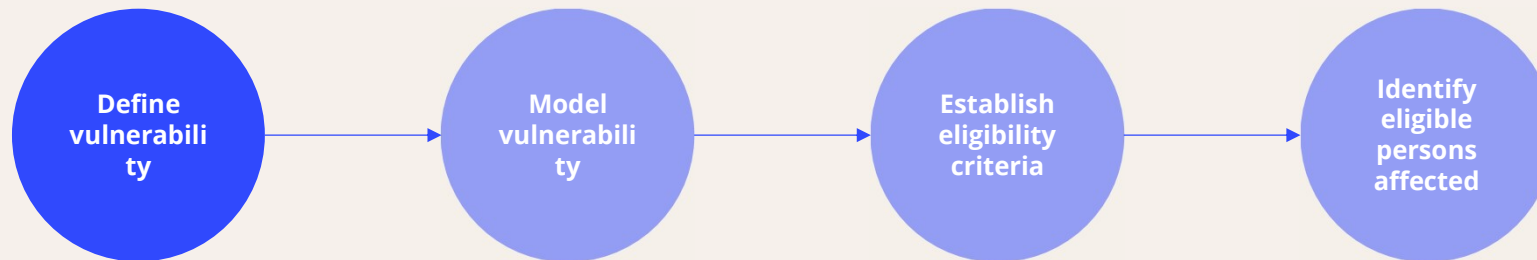
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HOW WE DO A DISTRIBUTION ALGORITHM

HOW WE COULD DO A DISTRIBUTION ALGORITHM



1. HO's define vulnerability through dependent variables
2. Design questions for persons affected to establish
 1. Their current situation (**independent variables**)
 2. Specific question relating defined vulnerability (**dependent variable**)
3. Through 121, collect dataset with household data of both independent and dependent variables
4. With the dependent variables, classify households, for instance
 - Vulnerable, not vulnerable
 - High vulnerability, moderate vulnerability, low vulnerability

HOW WE COULD DO A DISTRIBUTION ALGORITHM



Vulnerability (dependent variable)

121

Does your household have access to clean water?

Please select

- Yes
- No
- I do not know

121

Would you like to tell us more about this?

- Yes,
- No

HOW WE COULD DO A DISTRIBUTION ALGORITHM



Current situation
(independent variable)

?	○	○○○	\$
Your needs			
<p>121 We would like to understand the current situation of you, your household and your community. Could you please help us by answering these questions?</p>			
<p>121 please tell us about yourself and your household</p>			
<p>I am a</p> <p><input type="radio"/> male</p> <p><input type="radio"/> female</p> <p>My age is</p>			8
<p>121 If there are any more members in your household, please add household members</p>			
<p>Add household member</p> <p>Sex</p> <p><input type="radio"/> male</p>			9

Vulnerability (dependent variable)

121 Does your household have access to clean water?

Please select

Yes

No

I do not know

9

121 Would you like to tell us more about this?

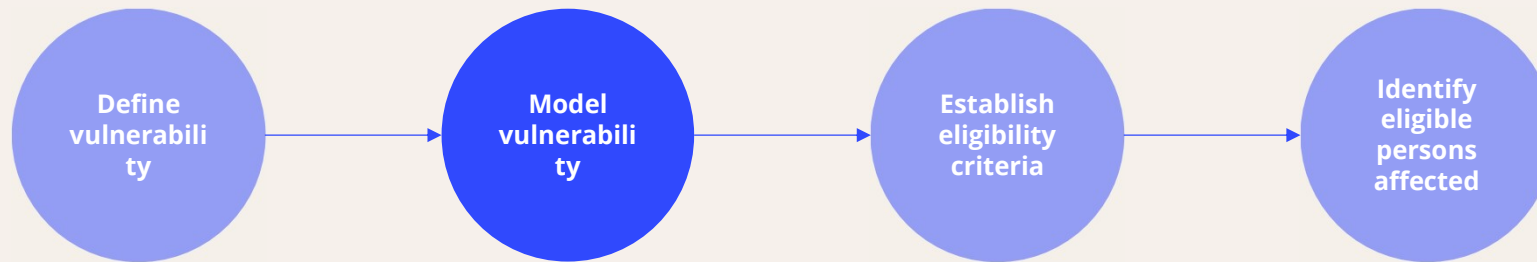
Yes,

.....

No

10

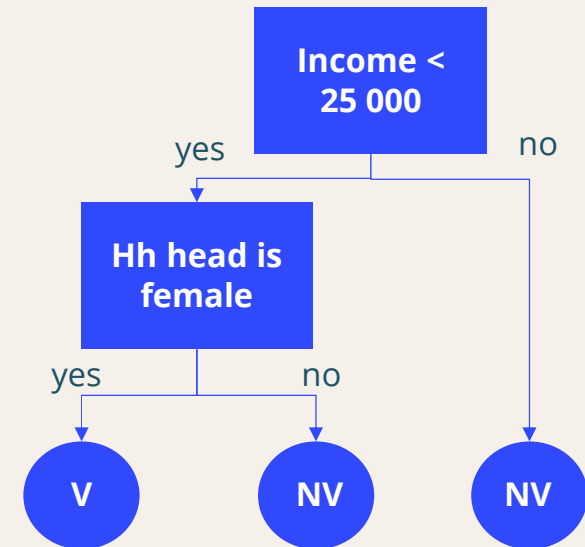
HOW WE COULD DO A DISTRIBUTION ALGORITHM



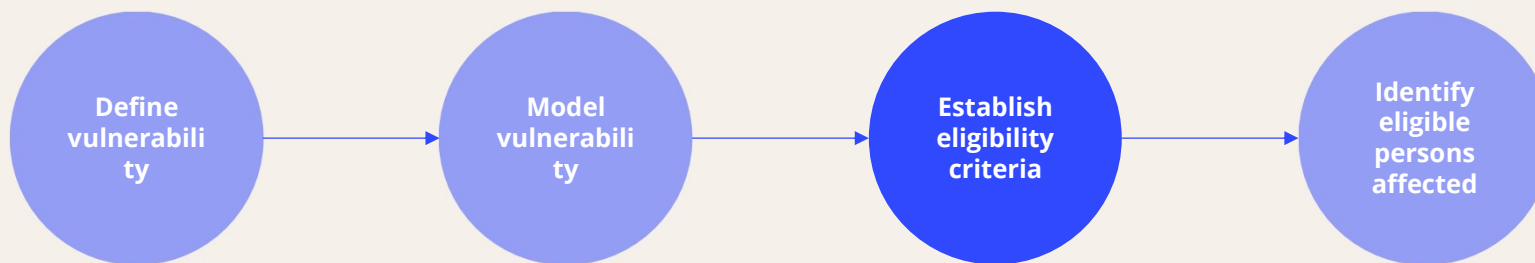
1. Use the dataset to create a **decision tree that classifies households' vulnerability.**

We use a machine learning technique to design the Optimal Classification Tree

- Only the **most important independent variables** are used
- Leads to an **interpretable model**, as opposed to many other machine learning and statistical techniques for classification
- Intuitive meaning that relates to objective of

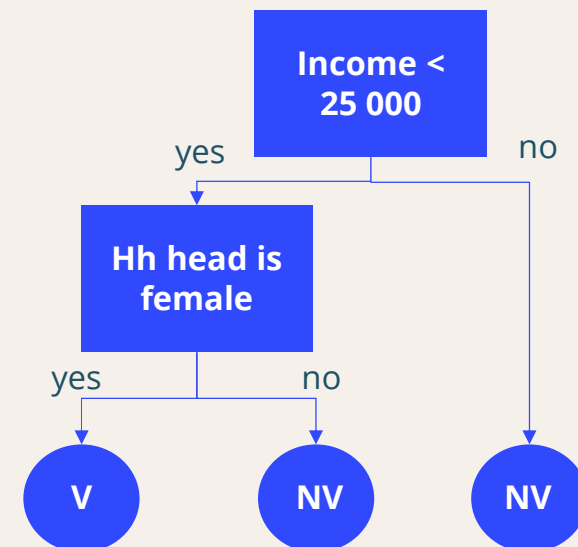


HOW WE COULD DO A DISTRIBUTION ALGORITHM

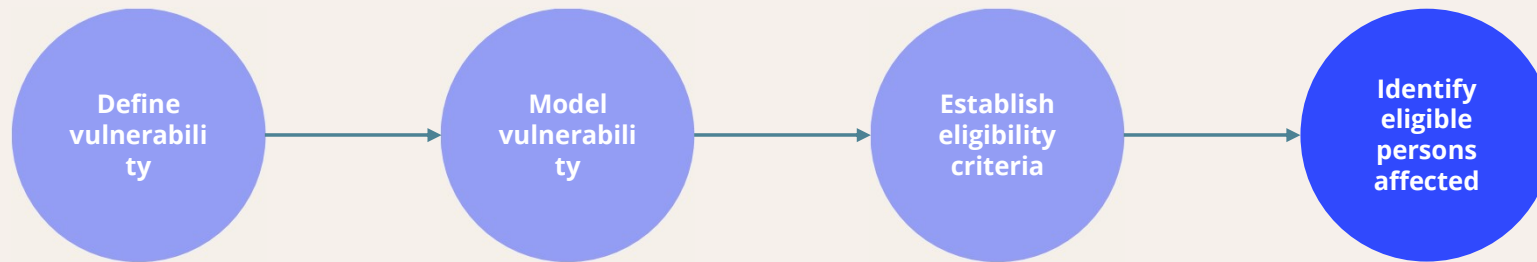


1. The decision tree naturally translates to targeting criteria

Example: households with an income less than 25 000 and a female head of household are classified as vulnerable, so this is the eligibility criterion



HOW WE COULD DO A DISTRIBUTION ALGORITHM



1. Ask all households that apply questions that are necessary to determine their eligibility
2. Include eligible households in the programme

Our eligibility criteria are ..., do you believe you are eligible and would you like to apply?



Limitations

Existing problems were

- Targeting criteria and processes are rarely understood by persons affected and/or donors
- Little transparency
 - **What** are the decisions?
 - **Why** are these decisions made?
- Little accountability
 - If we do not know **what** decision was made **why**, we cannot judge its **quality**

Does a distribution algorithm solve this?



NO!

Hiding behind complicated statistical models is not the answer!



NO!

Hiding behind complicated statistical models is not the answer!

To improve our decision-making processes and increase transparency and accountability, we need to leverage

- Direct contact with persons affected through 121
- Other data collection methods digitalization and (increased) connectivity bring along
- Statistical models and machine learning techniques

And

- The experience and contextual knowledge of humanitarian organisations and aid workers

WHY WE SHOULD NOT DO AN ALGORITHM



Person affected

Want a dignified response: **transparency, clear targeting** and **face-to-face communication**.

Humanitarian organizations

Want **ownership** over their targeting decisions.
Want **means to improve** decision-making

Donors

Want to fully understand the targeting decisions

DISTRIBUTION ALGORITHM

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HOW CAN 121 HELP WITH DISTRIBUTION

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Person affected

Offer ALL PA's the opportunity to **share their needs and priorities, and their knowledge** of the local situation (not just focus groups)

Establish a clear decision making process – **how is their input being transformed to decisions?**

Establish clear eligibility criteria

HOW CAN 121 HELP WITH DISTRIBUTION



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Establish clear eligibility criteria

Give HO's **means to improve** their (targeting) decisions

- The opportunity to gather needs and data immediately from PA's
- The opportunity to receive feedback on analysis results
- The opportunity to monitor programmes efficiently

Humanitarian organizations



Person affected

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Humanitarian organizations

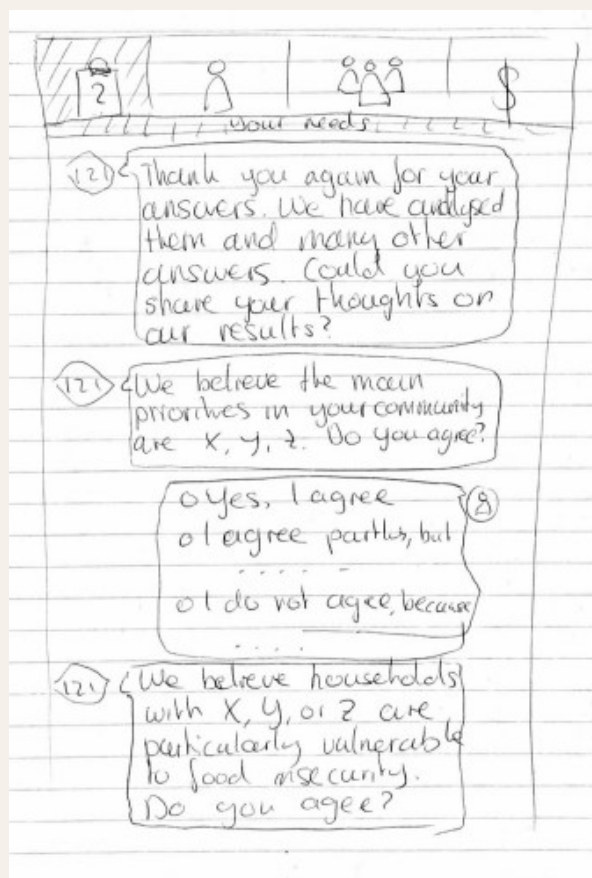
Donors

Give donor the opportunity to

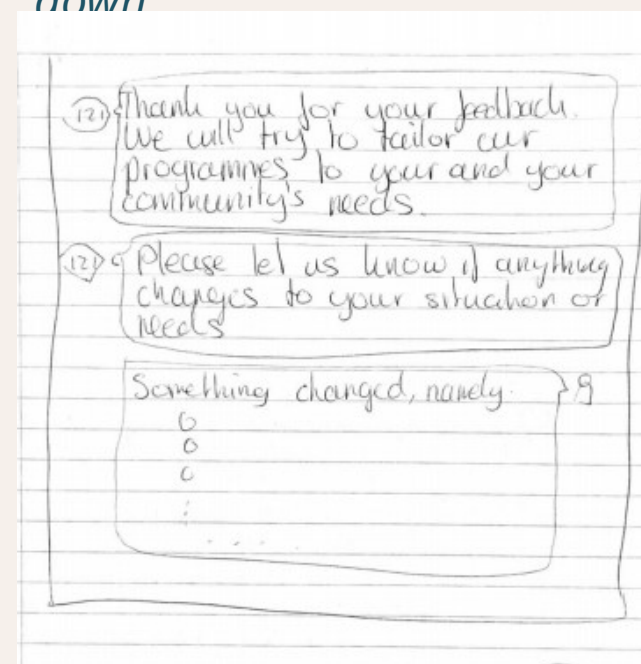
- **Understand the needs/data immediately** from PA's
- Monitor program results efficiently

HOW CAN 121 HELP WITH DISTRIBUTION

1. Ask persons affected
2. Receive feedback on results



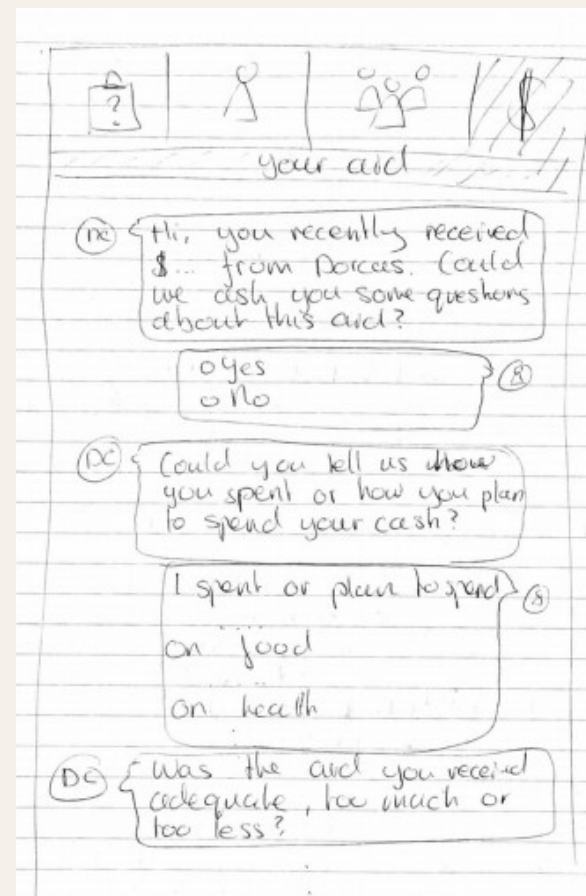
Data is the only thing that defies the law of gravity – it goes up but never comes down



HOW CAN 121 HELP WITH DISTRIBUTION



1. Give aid
2. Receive feedback on aid





- Current targeting practises
 - Are often **not understood** by persons affected and/or donors
 - **Lack transparency**
 - Make it difficult to hold humanitarian organizations **accountable**
- 121, in a digitally connected world, has the ability to improve this
- Completely taking over the decision-making process seems like the wrong solution for all stakeholders
- **121 needs to take on a facilitating role, in a way that**
 - **Dignifies and empowers persons affected**
 - **Assists aid workers and humanitarian organizations in their decision-making process**
 - **Allows donors to understand the needs/data immediately from PA's**
 - **Allows donors to monitor program results efficiently**



- Change the name of this module from 'distribution algorithm' to '**dignified targeting**'
- Research the specific **needs of all stakeholders** in the targeting process further
 - Focus on how they would make decisions if there were no technological limitations
- Research the possibilities of 121 **supporting other aspects of programme design**
 - Assessments
 - Monitoring and evaluation
 - Setting the transfer values
- Research the possibility of community based targeting through 121

ACKNOWLEDGEMENTS



- A big thank you to whole 510 team, and specifically the 121 team, for welcoming me
- Special thanks to Lars, Maarten, Orla and Jonath for guiding me through this process

HOW WE COULD DO A DISTRIBUTION ALGORITHM

1 2 3 4

1 2 3 4

My next step: Select program

- Select Dorcas program
- Select Red Cross program

DC The objective of our program is to help very poor or very vulnerable households buy essential food and non-food items. Based on the information you and many other households gave us about your needs and priorities, we have established eligibility criteria for our program. These are:

- Households with little assets and savings and no livelihoods, or
- Household with 5 or more children, or
- Households headed by children or elderly person (65+)

Do you think you are eligible and would you like to apply?

Yes, I believe I am eligible and would like to apply

No, I would not like to apply

DC Please answer the following questions:

Q1

...

Q2

...

DC Thank you. We have received your request. We will review your answers.

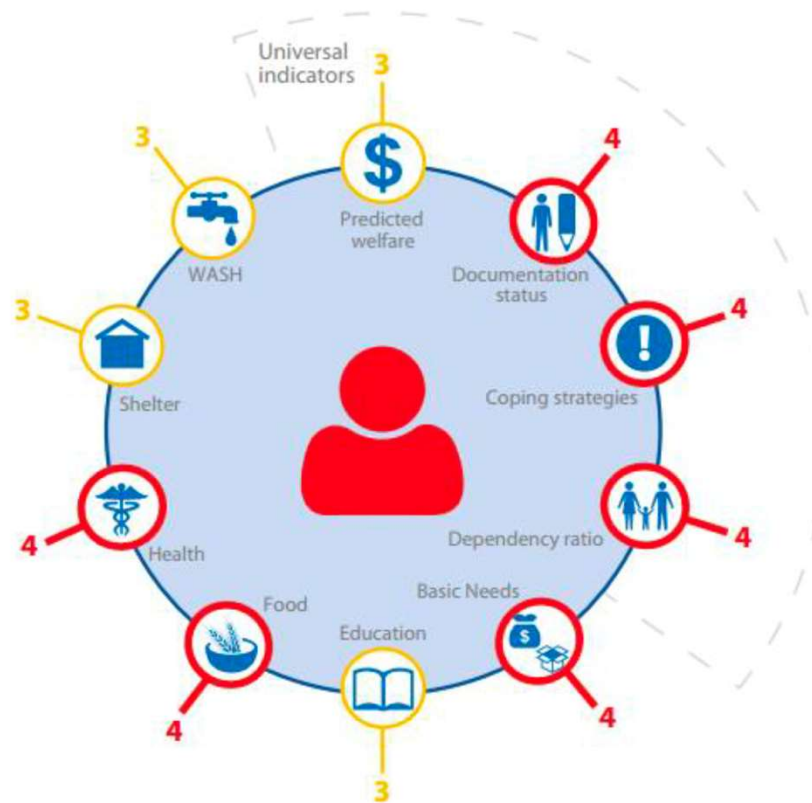
DC We could ask you to provide extra information or ask you to verify some of the information you supplied with our aid workers. We will let you know if any steps need to be taken.

DC We will let you know if you are included by August.

CASH BASED AID IN JORDAN



38 year old widowed Syrian female with 4 children.



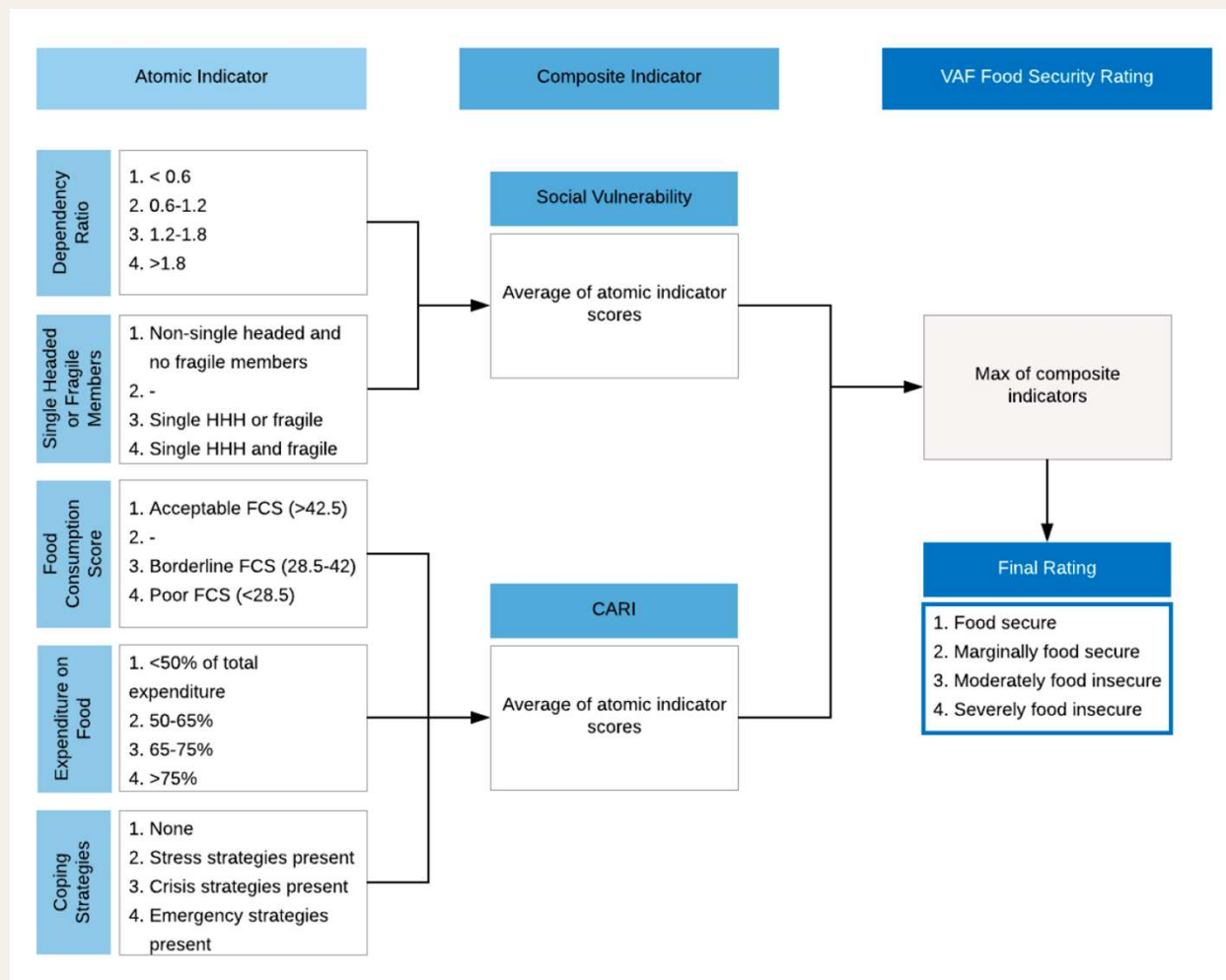
CASH BASED AID IN JORDAN



38 year old widowed Syrian female with 4 children.

\$	Predicted expenditure 3	Predicted per capita 43 JOD			
👤	Documentation status 4	PA Documentation PA is missing MOI	Family Documentation Family registered		
⚠️	Coping strategies 4	1 emergency strategy being implemented			
👨👩👧👦	Dependency ratio 4	1 autonomous adult 4 children			
💰	Basic Needs 4	Coping strategies Emergency strategies	Dependency ratio Poor dependency	Economic state High debt per capita	
📖	Education 3	Attendance risks Finance main risk	3 school aged children 2 years missed education 2 children attending		
🍲	Food 4	Social vulnerability High dependency ratio, Single headed	CARI score FCS = 103, 20% spent on food, Emergency		
🏥	Health 4	Access to services Missing PA doc, not had problems accessing	Family composition No under 5's and over 60s in case	Existing conditions Existing disabilities present	
🏠	Shelter 3	Housing conditions Missing essential items, showing poor signs	Security of tenancy Has contract but high debt	Family composition Female-headed house, high dependency ratio	
🚰	WASH 3	Health No issues	Access to latrines Shared access with 1 house and safe access	Access safe water Municipality source 1 instances without	Waste management 0 instance water 3 instances solid

CASH BASED AID IN JORDAN





Example

Programme objective: 'to increase the purchasing power of the Ugandan population so they can cover their basic needs'.

HO's want to classify households as vulnerable if they apply either of the following coping strategies:

- Distress sales of animal stock
- Household members migrated
- Reduced expenditure on health or education
- Rented out land or building
- Sent children elsewhere
- Sold durable assets
- Sold land or building

Example

We ask households questions about their current situation via 121. The answers do not affect eligibility

Region	Urban	Size hh	# children <5	Sex head	Coping Strat. 1	Coping strat. 2
Central	Rural	6	1	Female	More employment	Relied on savings
Kampala	Urban	5	0	Male	Reduced health expenditure	Changed dietary patterns involuntarily
Central	Urban	2	0	Male	Unconditional help relatives	-

Independent variables
Dependent variables



Example

We ask households questions about their current situation via 121. The answers do not affect eligibility

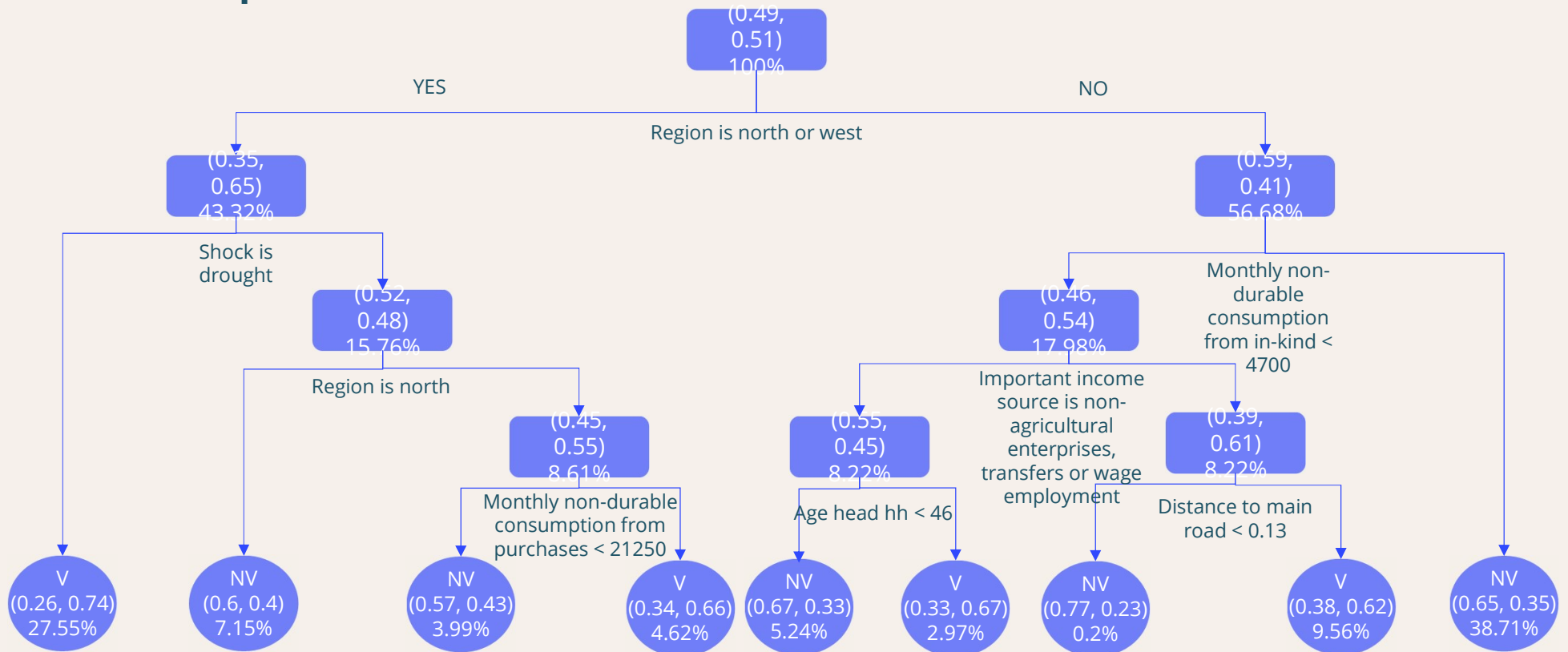
The observations are classified as per HO instructions

Region	Urban	Size hh	# children <5	Sex head	Coping Strat. 1	Coping strat. 2	Class
Central	Rural	6	1	Female	More employment	Relied on savings	Not vulnerable
Kampala	Urban	5	0	Male	Reduced health expenditure	Changed dietary patterns involuntarily	Vulnerable
Central	Urban	2	0	Male	Unconditional help relatives	-	Not vulnerable

Independent variables

Dependent variable

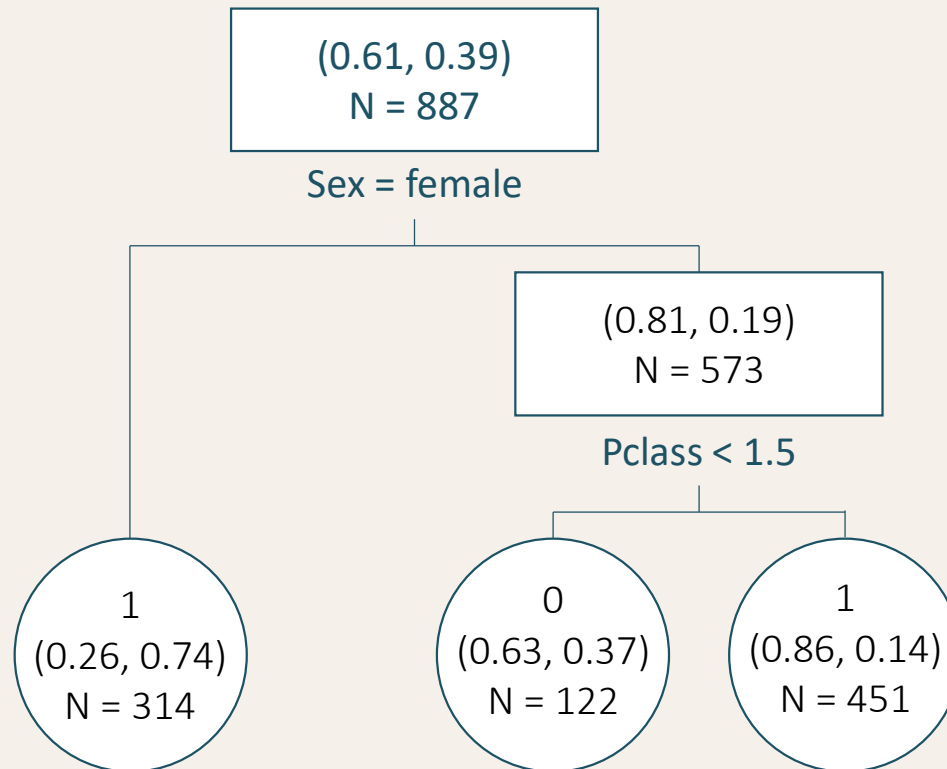
Example



OPTIMAL CLASSIFICATION TREE



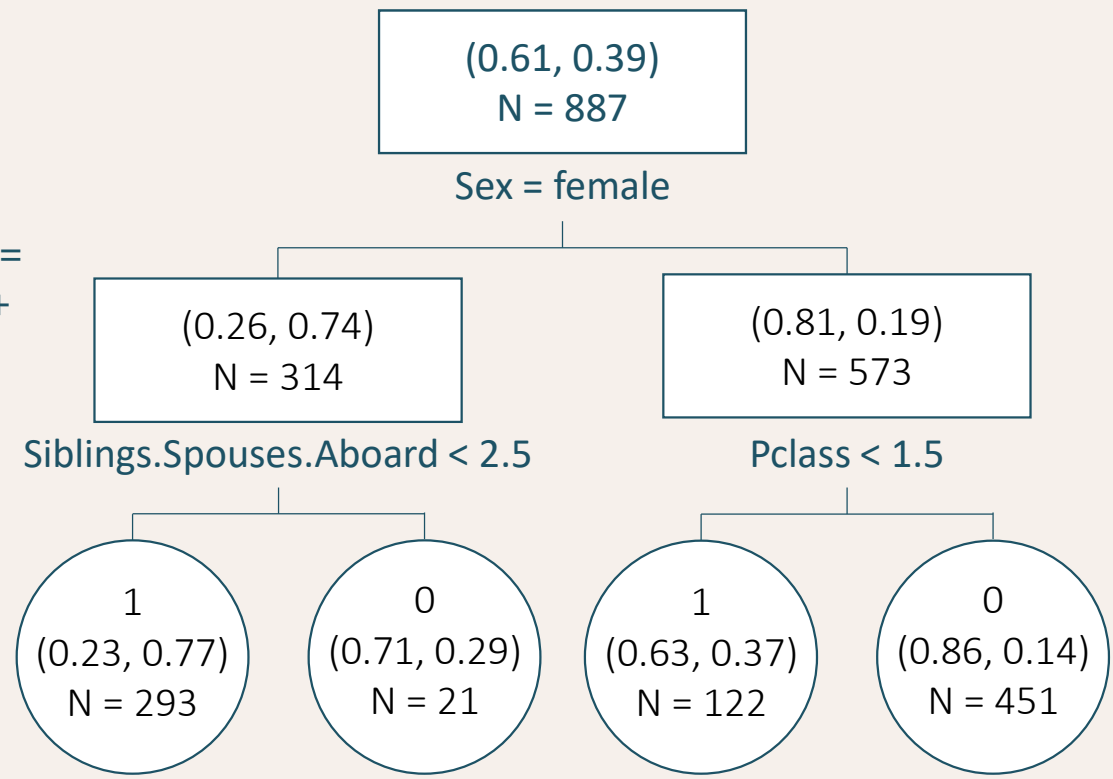
Misclassification
= 190 (81 + 45 +
64)



OPTIMAL CLASSIFICATION TREE



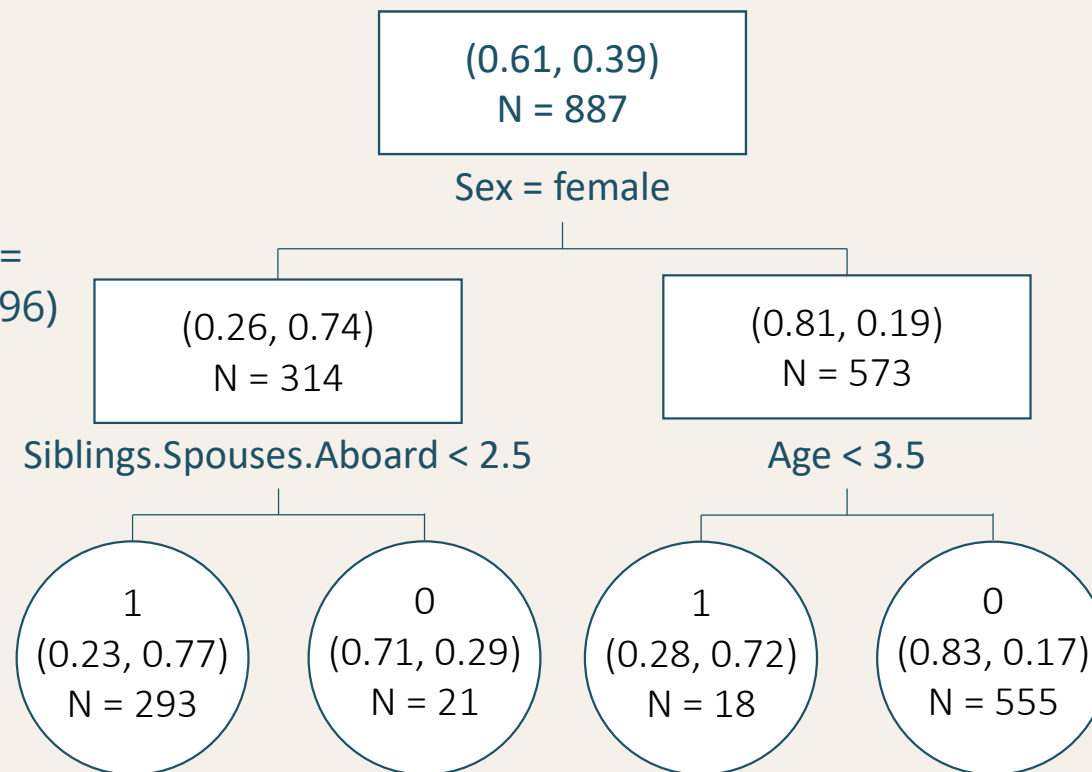
Misclassification = 181 (66 + 6 + 45 + 64)



OPTIMAL CLASSIFICATION TREE



Misclassification =
173 (66 + 6 + 5 + 96)





Adjusted for specific humanitarian purpose:

- Assume HO's find excluded vulnerable persons affected worse than included persons affected who are not considered vulnerable (*exclusion error vs inclusion error*)
- Then we do not want lowest misclassification rate, but we want to minimize

		Truth	
		Vulnerable	Not vulnerable
Model	Vulnerable	True positive	False positive (inclusion error)
	Not vulnerable	False negative (inclusion error)	True negative

Original:

$$\text{Error} = \# \text{ false positives} + \# \text{ false negatives}$$

Adjusted:

$$\text{Error} = \# \text{ false positives} + 1.5 * \# \text{ false negatives}$$