Livestock, Climate and System Resilience

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Science for resilient livelihoods in dry areas

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What forage tree-shrub species are recommended in alley cropping systems under west Asia conditions?

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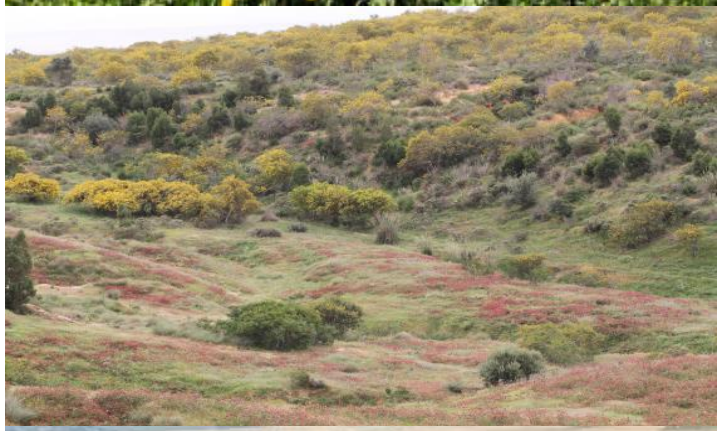
Transitioning to a Viable World

Agenda

- Facts about ASP Systems in WA
- Main causes of ASP degradation
- Key criteria for choosing right species
- Main findings
- Concluding remarks



Facts about ASP Systems

- **Areas:** Represent the largest land use
- **Land tenure:** Mostly state or tribal (communal)
- They are **dynamic complex ecosystems**
  - Spatial and temporal variability
- Aridity is high: **water** is a limiting factor
- Major gap in **feed resources**

Causes of ASP Degradation

Encroachment of agricultural practices into traditional ASP areas

Improper grazing practices: Overgrazing and early grazing

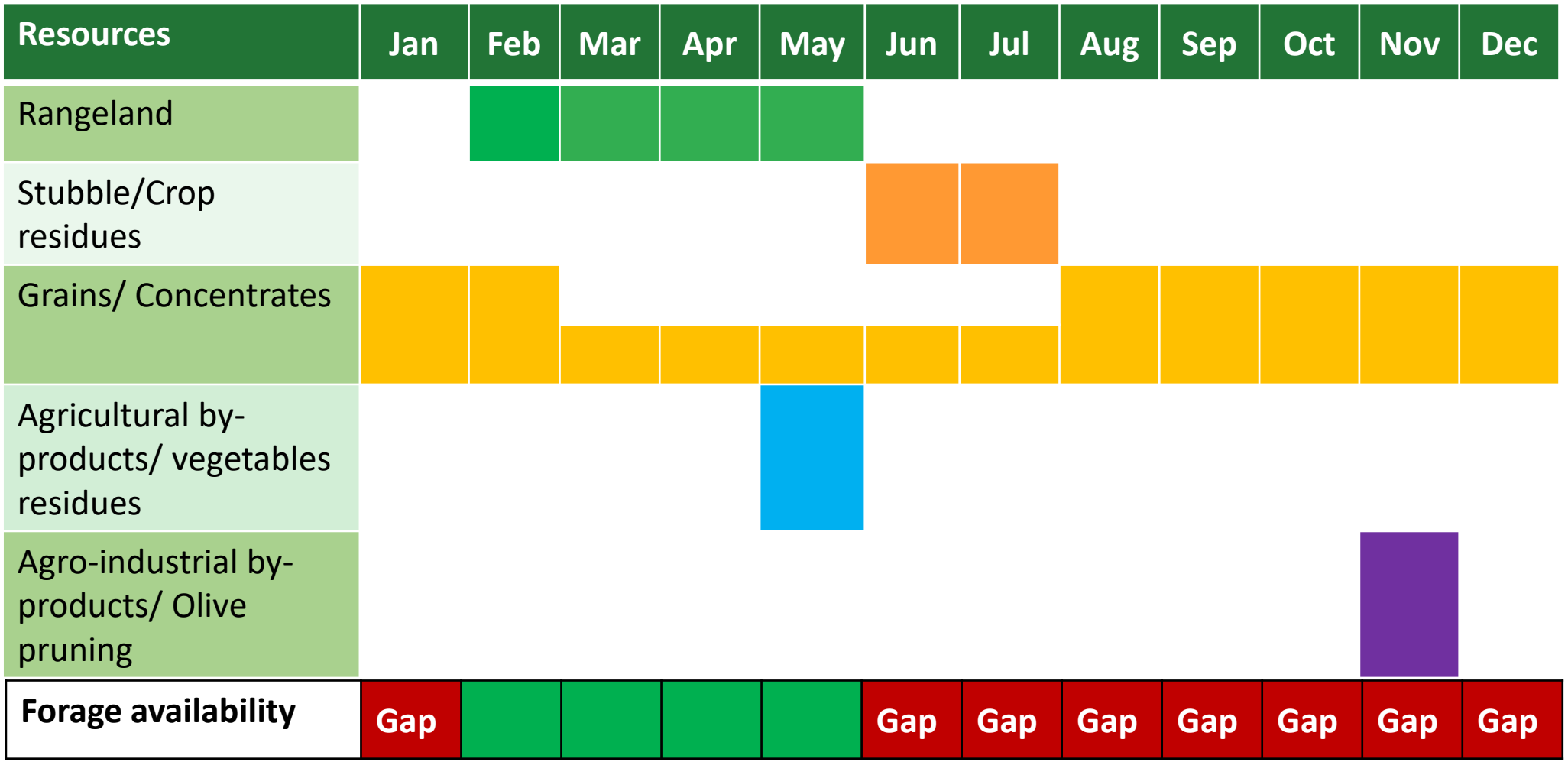
Removal of vegetation for foraging, fuel and medicinal purposes (uprooting)

Disruption of the traditional grazing system: Use of vehicles for transportation of water to the herds and of the animals to new pastures fosters prolonged grazing on rangelands and uncontrolled movement of the herds.

Weak institutional support and policy

- Subsidized animal feed
- Lack of Intergovernmental Rangeland Institution

Feed Calendar of Small Ruminants (Jordan)



These limited resources available to smallholder livestock keepers, leading to a need to promote low-input agroforestry practices

Alley cropping

Alley cropping also known as hedgerow intercropping is an agroforestry system in which planting crops between trees and shrubs

Benefits of alley cropping

- **Provides fodder in times of scarcity**
- Provides rich and diverse diet for livestock
- Improves soil fertility (increased SOC and nitrogen)
- Reduces erosion and serves as windbreaks
- Improves crop performance
- **Provide numerous goods and services essential for the livelihoods of the agro-silvo-pastoralists.**

Study Objective

1 What is your goal?

The objective of this study was to evaluate the performance of various shrubs as potential hedgerow species for alley cropping systems under west Asia conditions.

Plant materials

Seven shrubs' species were evaluated in this study including:

- 3 Leguminous species: *Medicago arborea, Colutea istria* and *Coronilla glauca*
- 3 Atriplex species: *A. canescens, A. nummularia* and *A. undulata*
- Spineless cactus pear (*Opuntia ficus-indica*)

All these species were integrated within field crops consisting of wheat, vetch and barley in Mushaqqar Research Station (Jordan). Each crop was planted in strips measuring 10m wide and 100m long, while the shrubs intra line spacing was 2.5m.

Medicago arborea
tree medic

Medicago arborea

Benefits:

- **Is excellent feed for livestock due to its high protein content**
- **High palatability**
- **Long lived (at least 25 years)**
- **Improve soil fertility**

Colutea istria

Bladder Senna

Basal shoots upright shrub grows to 3 m tall, deciduous plant prefers neutral and mild alkaline soils. Leaves are light-green, hairy and stringy made up of nine to fifteen small obovate leaflets with white trampled hairs ends. It is in flower in March May. Fruits are Paper-like, 5 to 8 cm long contain black brown seeds

Benefits:

- **Highly palatable**
- **An excellent feed for livestock due to its protein content**
- **High palatability**
- **Moderately drought tolerant**
- **Melliferous species**
- **Improves soil quality**

Coronilla glauca

Glaucous scorpion-vetch

It is an evergreen plant and has blue-grey, pinnate leaves 1 m high, grow in light, moderately fertile, well-drained soils. It is cold and frost tolerance (greater than *Medicago arborea*), flowering period: February to April

Benefits:

- **Highly palatable**
- **Melliferous species with yellow flowers that are highly attractive to bees**
- **Grows in semi-arid areas (400 600 mm)**
- **High feed values**
- **Improves soil quality**

Atriplex canescens

Four-wing saltbush

Benefits:

- **It has high vegetative vigor**
- **Grows well under saline-sodic conditions**
- **High drought tolerant**
- **Excellent species for erosion control**
- **Crude protein content (leaves) ranges from 12.5 to 15.7%**
- **Moderate to high palatability**

Evergreen shrub, mature plants range from 0.3 to 2.5 m in height while leaves are simple, 0.5- 5 cm long. It is dioecious plant species and fruit has winged utricle that becomes yellow when ripe

Atriplex nummularia
oldman saltbush

Benefits:

- **Drought resistant**
- **Can grow in areas with high salinity (max 300 mM)**
- **Is a good maintenance feed when other feed sources are depleted**
- **Is grown in arid areas all over the world**
- **Adequate source of crude protein**

To get maximum profit from the runoff, seedlings were transplanted in constructed micro-catchments, with a spacing of least 1.5 m apart. Due to the steepness of the slopes, spacing between rows varied between 2 to 3 m. The micro-catchments were established using tools that are readily available and can be implemented on land slopes with variable soil depth.

Atriplex undulata

Wavy-leaved saltbush

Short-lived perennial shrub to 1 m high and up to 1.5 m wide. Low Leaves 0.5–2 cm long, can reach 5 cm. Dioecious plant species and fruits mature in autumn

Benefits:

- **Good crude protein content with low energy value**
- **Salt and drought tolerance**
- **Grazing value is higher when grown with other annual spices**
- **Moderate palpability**

Opuntia ficus-indica
(Cactus pear)





Benefits:

- **Drought-tolerant**
- **Evergreen plant**
- **Easy to establish, maintain, and use**
- **Multipurpose species**
- **High fodder potential**
- **Resolves livestock watering in the dry areas**
- **High palatability**
- **High in soluble carbohydrates**

Sampling and data collection

- Growth characteristics were measured through monitoring shrub stem diameter, stomatal conductance and plant height.
- Shrubs/trees were clipped (mimic browsing) to determine aboveground biomass production.
- A suitability index was computed for each shrub species based using "**Weighted Factor Model** “

2 Define criteria

Forage dry matter (DM) yield is important in budgeting feed and making management decisions such stocking rates

01 Forage production

Forage nutritive value plays a significant role in the formulation of the livestock diet and maintaining sustainable ecosystems, and grazing management

02 Forage quality

Growing appropriate shrubs that their seasonal growth and the rationale for integrating forage shrubs into grazing systems could partially help filling the seasonal forage gaps

03 Season for direct browsing

Functional characteristics of shrubs directly or indirectly affect their foraging patterns, determine how naturally fit into grazing and make predictions about grazing response

04 Ability for direct browsing

With different magnitudes according to species, shrubs are of vital importance for the accumulation of nutrients and maintenance of soil fertility

05 Impact on soil fertility

Recommend shrub/tree to grow

Reduce the feed gap

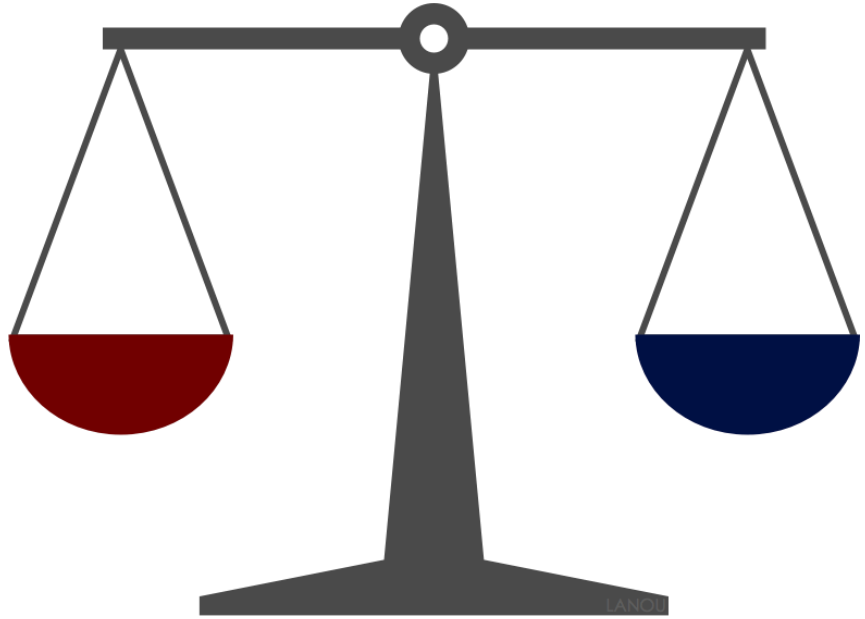
We came up with a list of criteria to determine priorities and assign a bigger value to those we think are more important criteria to consider through our decision making

Weighted Factor Model

3 **Setting up relative importance**

We start by establishing a weight of **relative importance** for each of these criteria.

Criteria	Description	Weight
1	Forage production	20%
2	Forage quality	20%
3	Season for direct browsing (timing with peak standing crop)	30%
4	Ability for direct browsing (no damage to target plant)	25%
5	Impact on soil fertility.	5%



Weighted Factor Model

4 **Multiply the weight by the score**

Criteria	Forage production	Forage quality	Season for direct browsing	Ability for direct browsing	Impact on soil fertility	Total
Weight / Shrub	**20%**	**20%**	**30%**	**25%**	**5%**	
A. canescens						
A. nummularia						
A. undulata						
C. glauca						
C. istria						
M. arborea						
O. ficus-indica						
A. canescens						

- Weighted Factor Model

4 **Multiply the weight by the criteria value**

	Forage production	weight	Forage Production score	Forage Quality	weight	Forage quality score
Weight / Species		20%			20%	
A. canescens	5	20%	1	3	20%	0.6
A. nummularia	4	20%	0.8	3	20%	0.6
A. undulata	3	20%	0.6	3	20%	0.6
C. glauca	2	20%	0.4	3.5	20%	0.7
C. istria	1	20%	0.2	4	20%	0.8
M. arborea	2	20%	0.4	5	20%	1
O. ficus-indica	2	20%	0.4	2.5	20%	0.5

- Weighted Factor Model

4 **Multiply the weight by the criteria value**

	Season for direct browsing	weight	Season for direct browsing score	Ability for direct browsing	weight	Ability for direct browsing score
Weight / Species		**30%**			**25%**	
A. canescens	5	30%	1.5	5	25%	1.25
A. nummularia	5	30%	1.5	5	25%	1.25
A. undulata	5	30%	1.5	5	25%	1.25
C. glauca	1	30%	0.3	5	25%	1.25
C. istria	1	30%	0.3	4	25%	1
M. arborea	1	30%	0.3	5	25%	1.25
O. ficus-indica	0	30%	0	0	25%	0

- Weighted Factor Model

4 **Multiply the weight by the criteria value**

	Impact on soil fertility	Weight	Score
Species \ Weight		**30%**	
A. canescens	1	5%	0.05
A. nummularia	1	5%	0.05
A. undulata	1	5%	0.05
C. glauca	5	5%	0.25
C. istria	5	5%	0.25
M. arborea	5	5%	0.25
O. ficus-indica	1	5%	0.05

- Weighted Factor Model

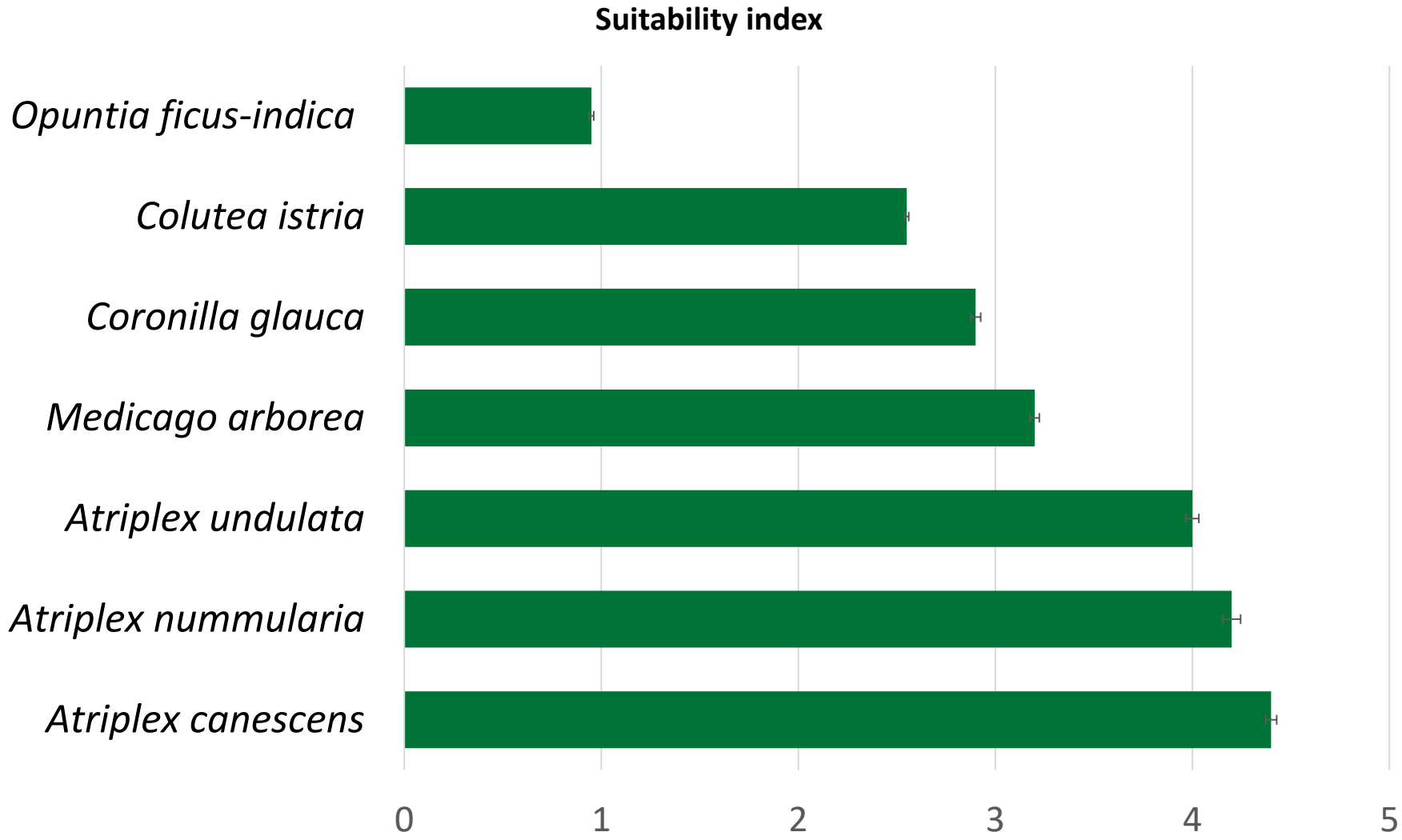
5 **Get total of the weighted score**

	Forage Production score	Forage quality score	Season for direct browsing score	Ability for direct browsing score	Impact on soil fertility score	Total weighted score
A. canescens	1	0.6	1.5	1.25	0.05	**4.4**
A. nummularia	0.8	0.6	1.5	1.25	0.05	**4.2**
A. undulata	0.6	0.6	1.5	1.25	0.05	**4**
C. glauca	0.4	0.7	0.3	1.25	0.25	**2.9**
C. istria	0.2	0.8	0.3	1	0.25	**2.55**
M. arborea	0.4	1	0.3	1.25	0.25	**3.2**
O. ficus-indica	0.4	0.5	0	0	0.05	**0.95**

Results of weighing and ranking

5 **Make decision based on the highest score**

Overall based on all the criteria and all the weight A. canescens is the better choice



Main findings

- Atriplex species (*A. canescens*) performed well and can be an ideal species for establishing alley cropping under WA conditions.
- The multiple benefits of alley cropping can only strengthen resilience of the production system **to sustain livelihood of the agrosilvopastoral communities.**

Concluding remarks

Other criteria (factors) to consider:

- Availability seeds and/or seedlings (major handicap)
- Selecting multi-purpose species (trees, shrubs and herbaceous species) based on a combination of socio-economic and environmental criteria (involve local community in the decision making)
- Favoring as much as possible the use of native and adaptive species
- Fast versus slow growing (establishment)
- Select species that require minimum care and protection:
  - Less capital and labor demand
  - Social fencing versus physical fencing (since crop is planted between rows this is relatively safe. Only risk is after crop harvest especially for cereals)
- **Use of trees and shrubs in alley cropping is site specific – no one single rule fits everywhere!!**

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Thank you

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