A scheduling model for forage harvesting

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Background

Grass silage quality has major influence on milk yield

Grass silage quality can save import of concentrates

It has influence on the GHG budget.

In Denmark 1/3 of grass silage is too wet and 1/3 is too dry.

Many planning models on harvest and route planning have been launched

Objective

Can we make a scheduling model for the optimal time for initiating various operations related to the harvesting and treatment of grass forage.

The scheduling model is based on moisture predictions

The model anticipates three levels of decision:

1. Harvest
2. Uncertainty
3. No harvest

biomass operations

Inputs for the model

Should be possible for the farmer to fill-in

Expected yield (would prefer biomass map)

Potential field working hours for cut

Potential field working hours for picking up

Potential field working hours for spreading and raking

Field coverage

Moisture prediction model of Atzema, (can use online weather forecast)

The DSS

1st stage decision making (1sDM)

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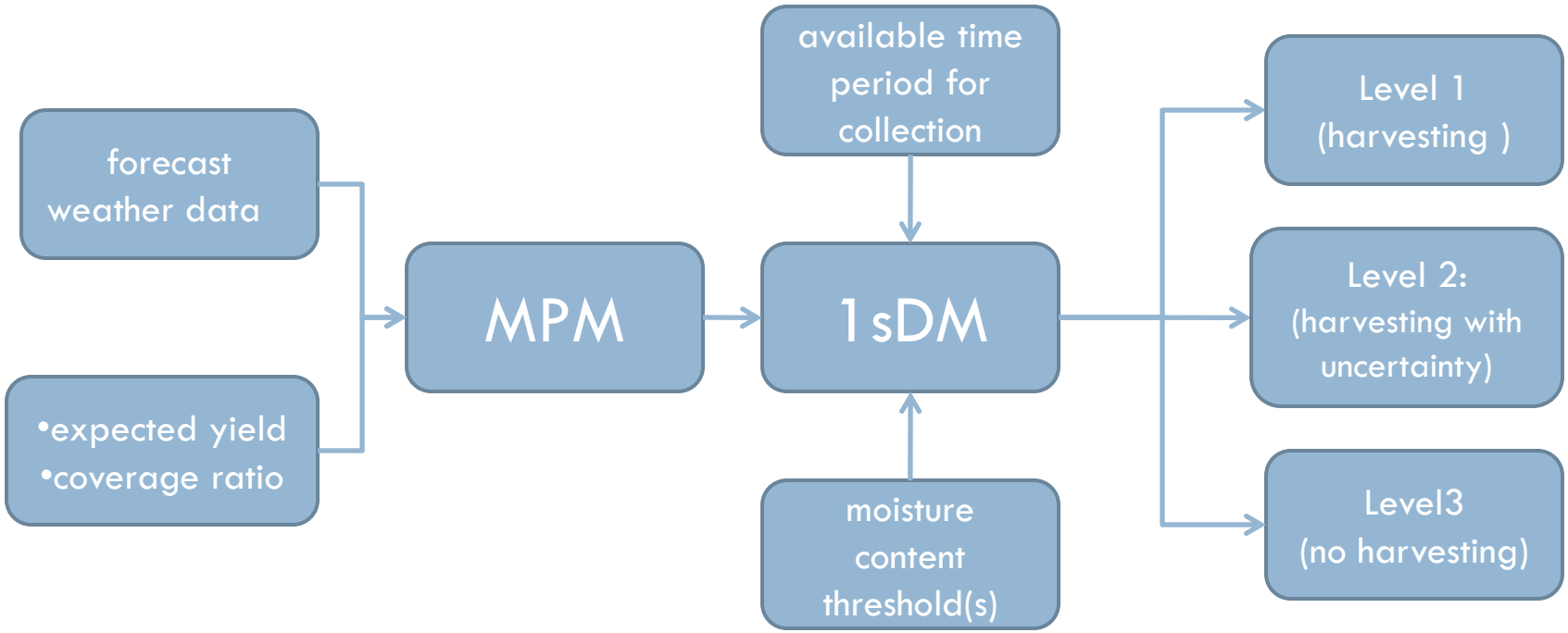

The DSS

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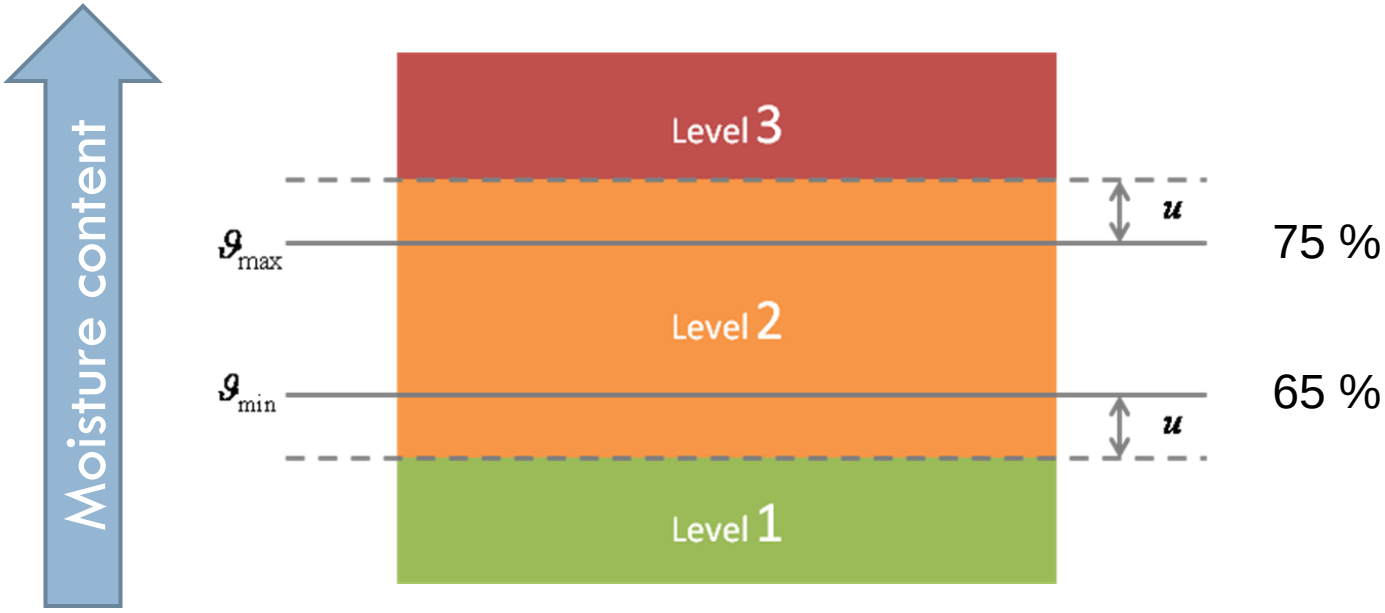

The Moisture prediction model (MPM)

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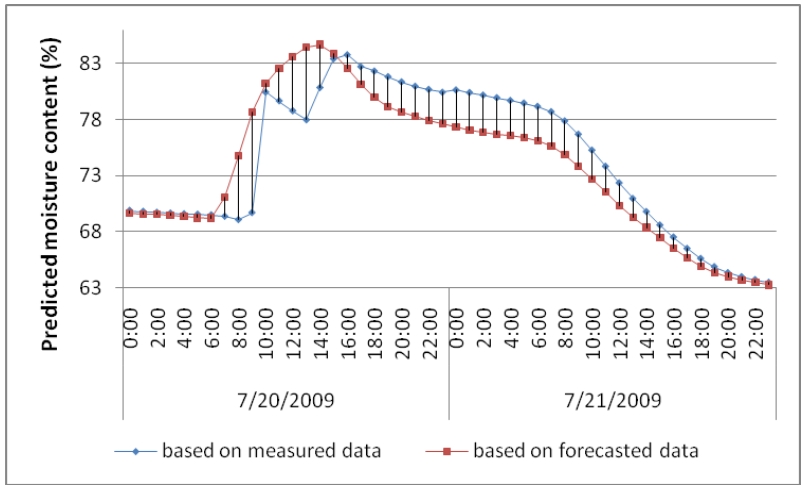

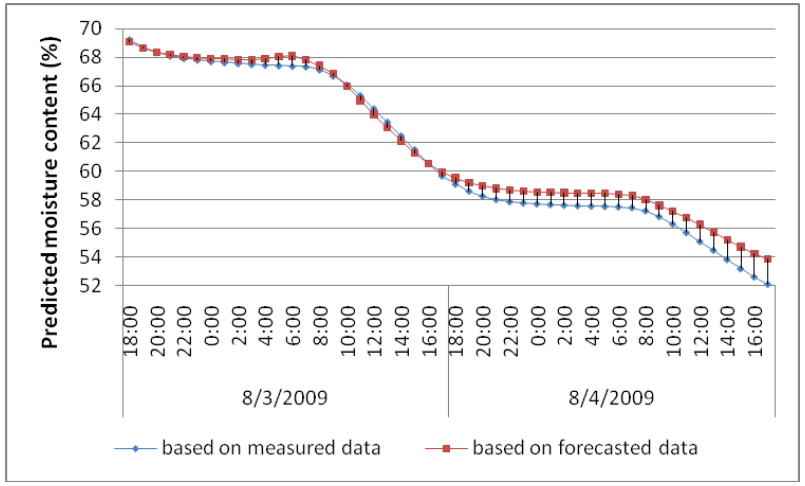

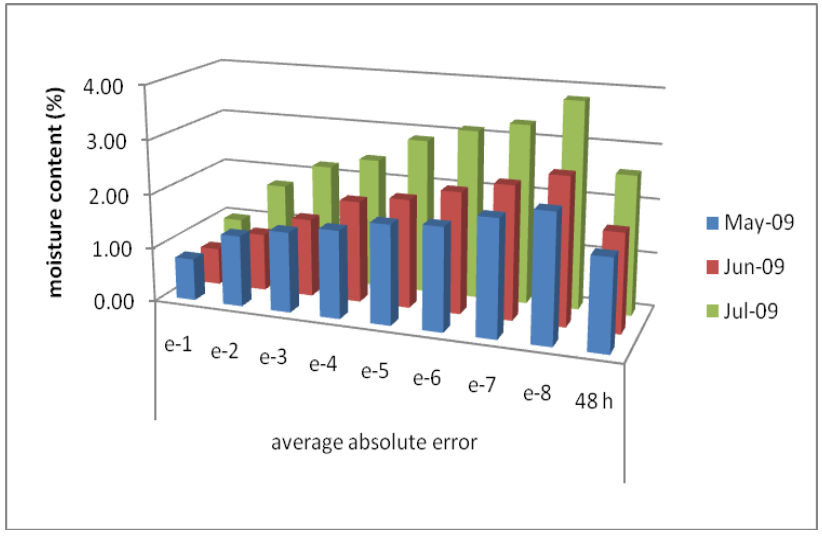

Average absolute error
= 2 percent

The DSS

1st stage decision making (1sDM)

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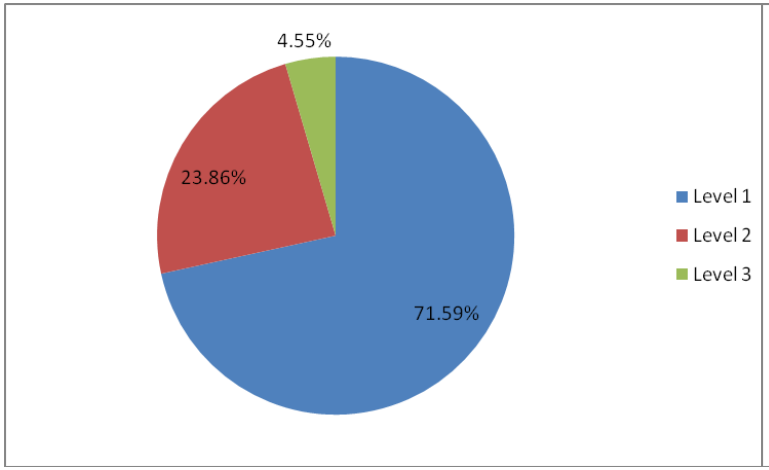

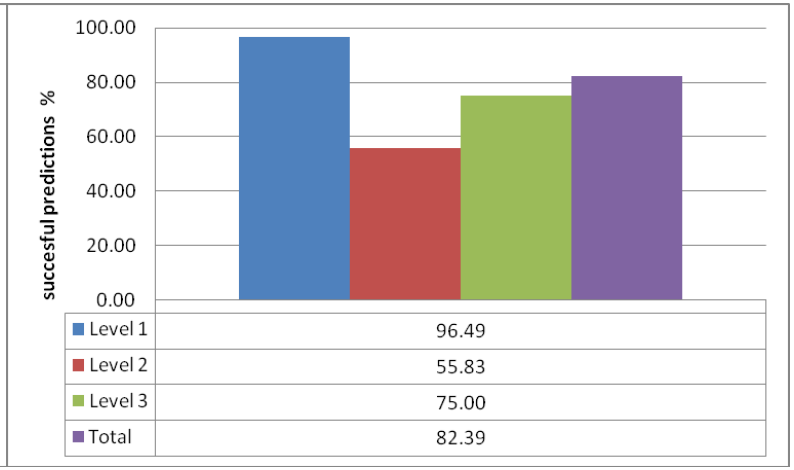

The distribution of the predicted levels of moisture content by the 1sDM	The percentage of successful predictions

The DSS

2nd stage decision making (2sDM)

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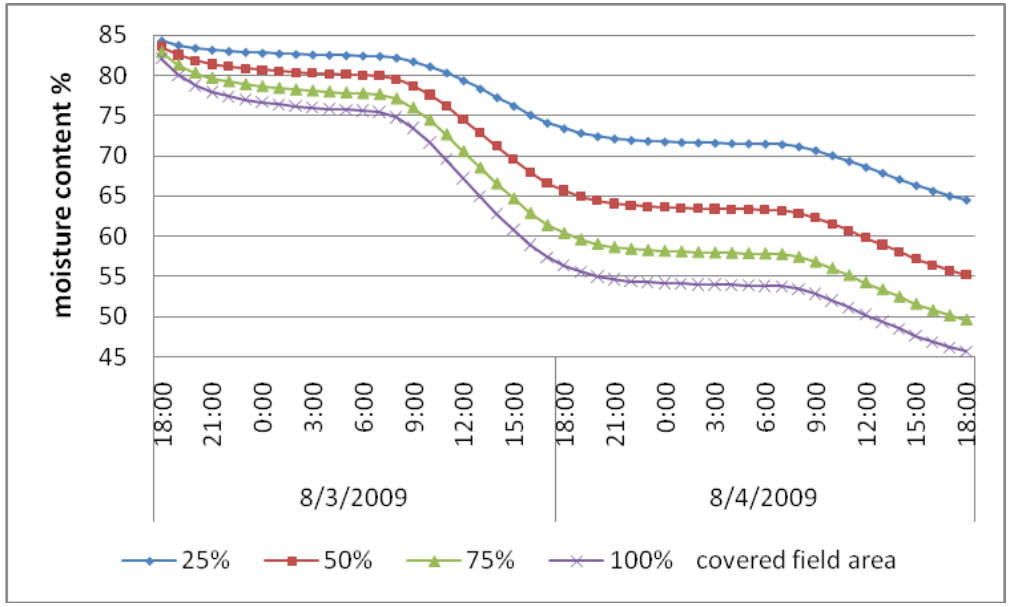

Different covering percentage results in different drying rates for the grass

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2nd stage decision making (2sDM)

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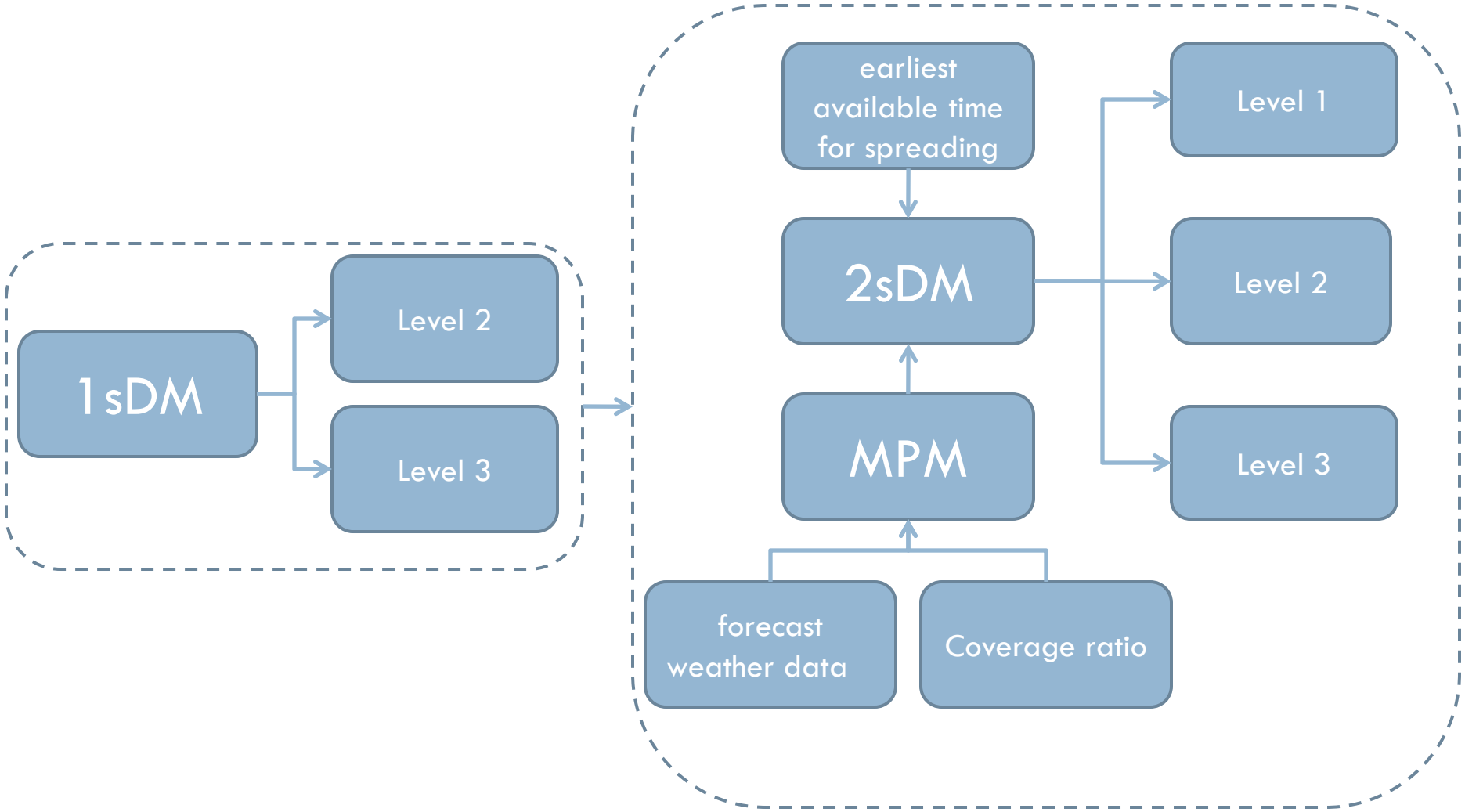

The DSS

2nd stage decision making (2sDM)

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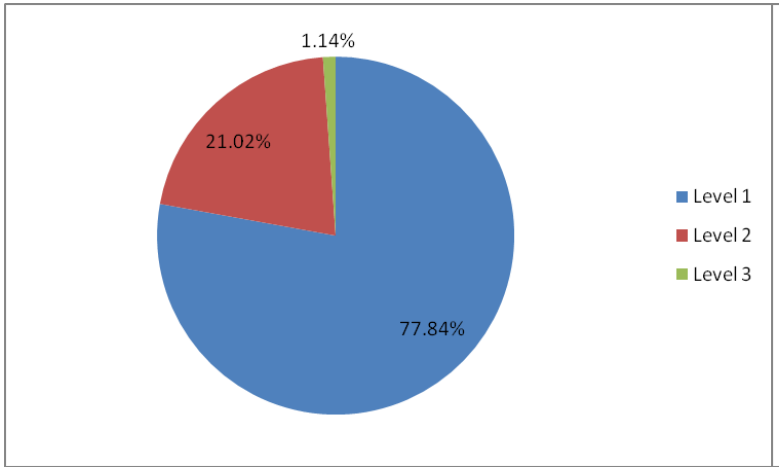

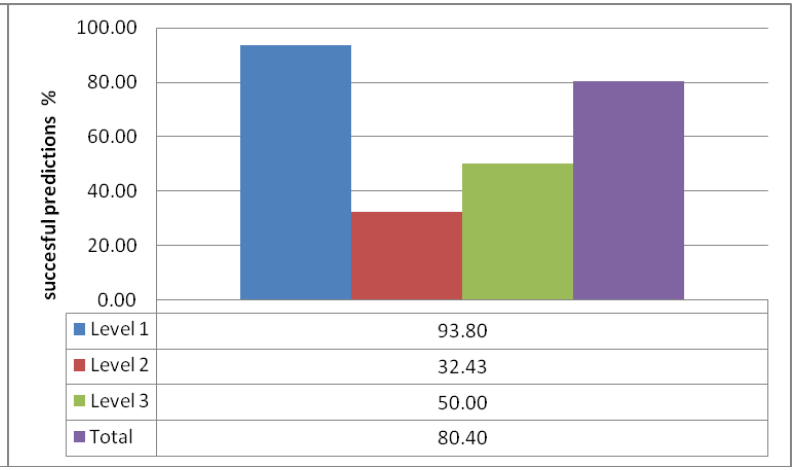

The distribution of the predicted levels of moisture content by the 2sDM

The percentage of successful predictions

DSS evaluation

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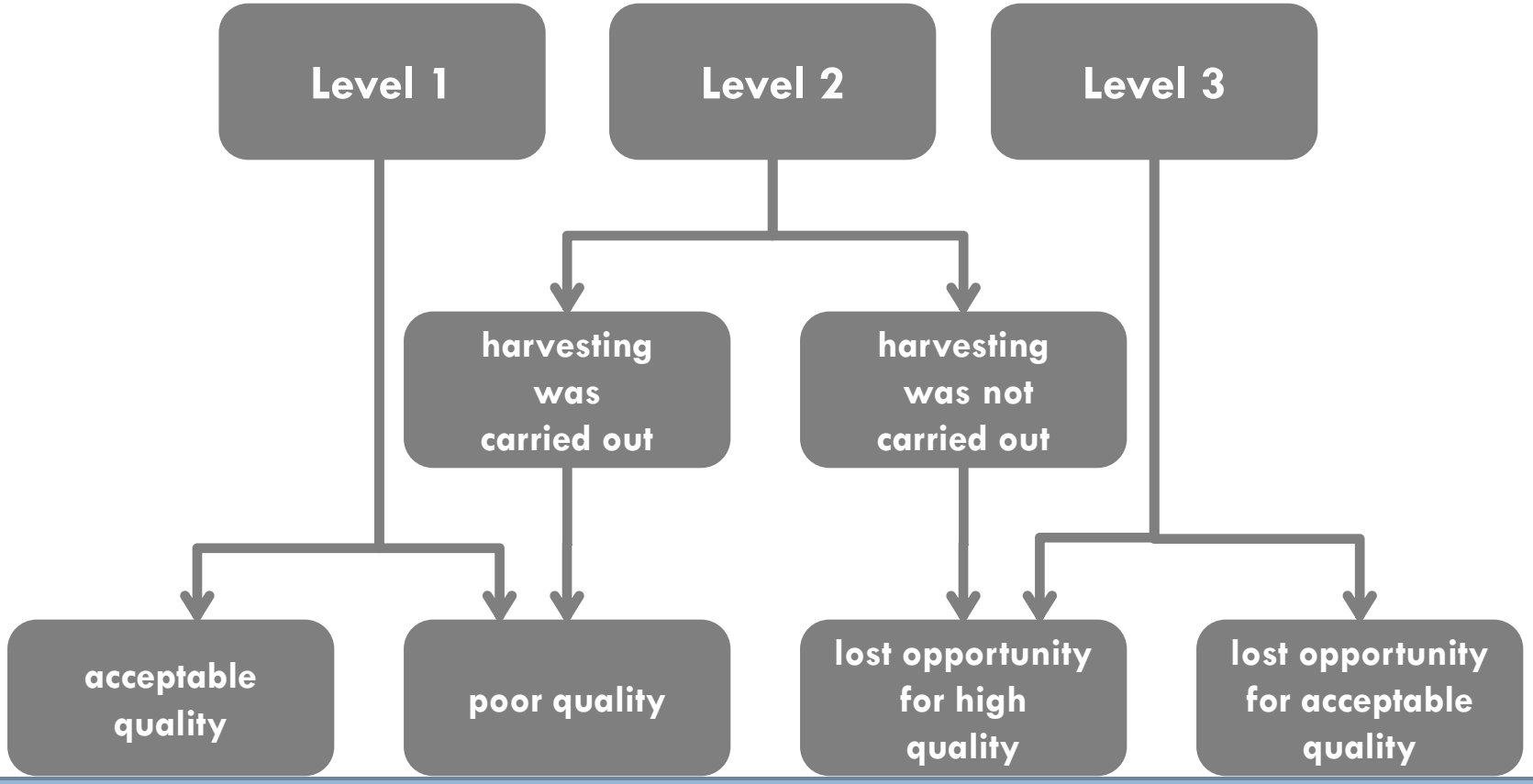

Unwanted outcomes from harvesting decision making based on unsuccessful level predictions

DSS evaluation

Percentages of the undesirable outcomes from unsuccessful level predictions

[#] The farmer proceeds to the harvesting operation based on the decision 2 suggestion

[&] The farmer does not proceed to the harvesting operation based on the decision 2 suggestion

		reduced quality (%)	poor quality (%)	lost opportunity (%)		Total (%)
				acceptable quality	high quality	
1sDM	D2+[#]	1.99	3.12	0.28	0	5.39
	D2-[&]	1.99	0.28	0.28	12.22	14.77
2sDM	D2+	4.26	6.54	0	0.57	11.37
	D2-	4.26	0.57	0	1.14	5.97

Conclusion

- The percentage of successful suggestions ranged from 83.33% to 94.61%.
- The developed model may be seen as a prototype for a decision support system, providing recommendations on the optimal execution of grass harvesting operations.
- The development of such a system in a contractor-level (multiple-fields) is necessary and could provide multiple benefits.

scheduling tool for biomass field logistics

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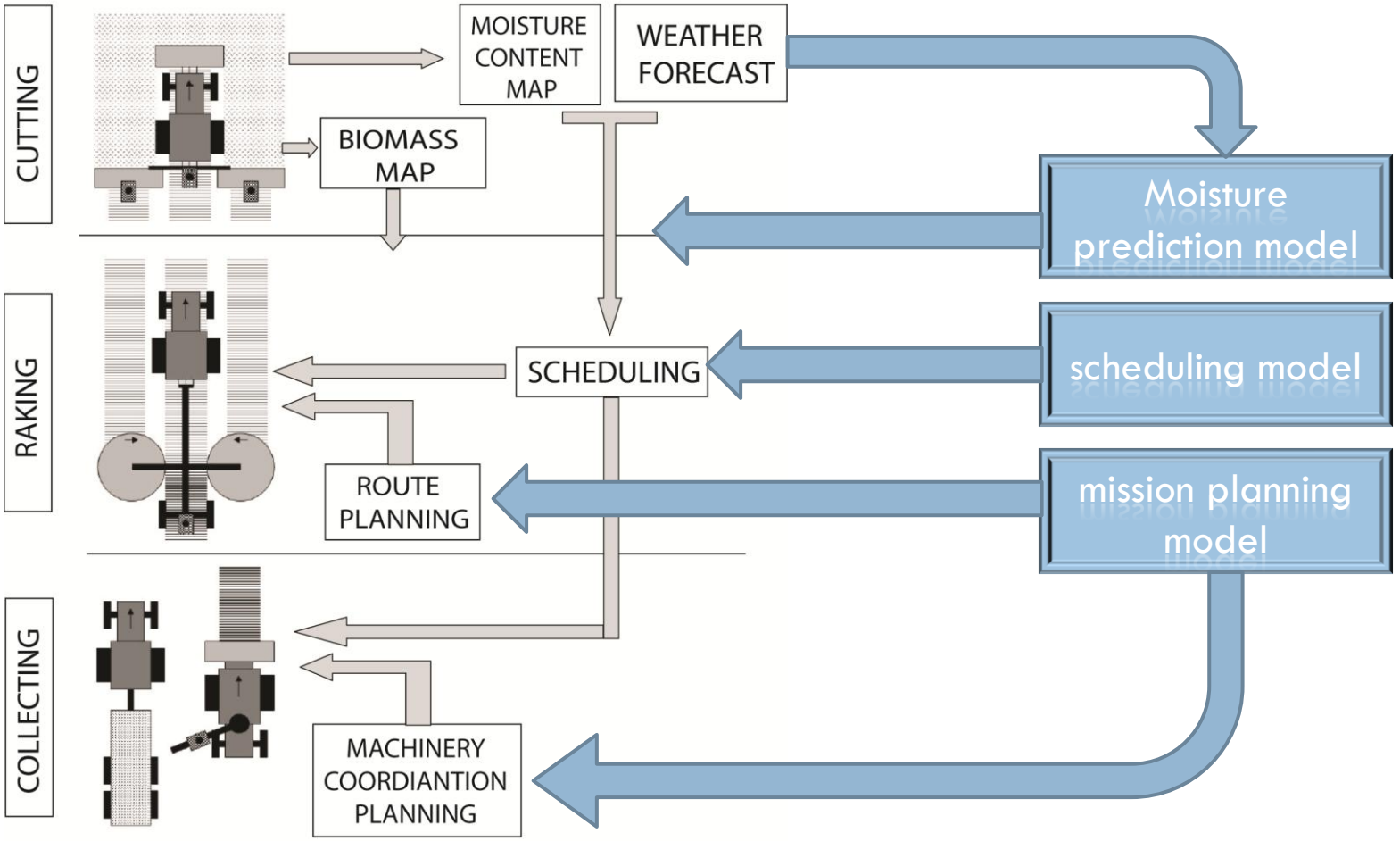

Thank you for your attention !

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