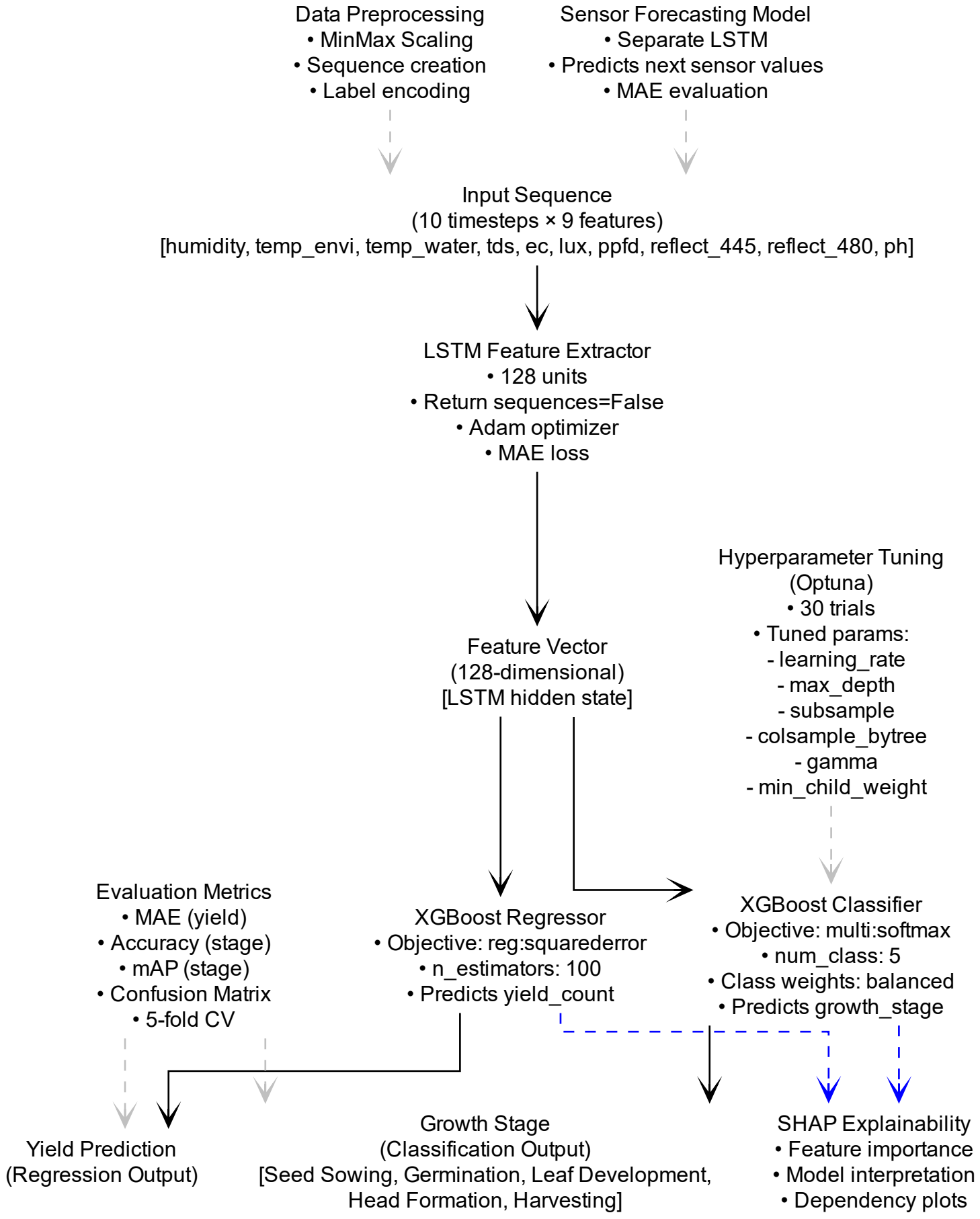
Data Preprocessing
• MinMax Scaling
• Sequence creation
• Label encoding
Sensor Forecasting Model
• Separate LSTM
• Predicts next sensor values
• MAE evaluation
Input Sequence
(10 timesteps × 9 features)
[humidity, temp_envi, temp_water, tds, ec, lux, ppfd, reflect_445, reflect_480, ph]
LSTM Feature Extractor
• 128 units
• Return sequences=False
• Adam optimizer
• MAE loss
Feature Vector
(128-dimensional)
[LSTM hidden state]
Hyperparameter Tuning
(Optuna)
• 30 trials
• Tuned params:
- learning_rate
- max_depth
- subsample
- colsample_bytree
- gamma
- min_child_weight
Evaluation Metrics
• MAE (yield)
• Accuracy (stage)
• mAP (stage)
• Confusion Matrix
• 5-fold CV
XGBoost Regressor
• Objective: reg:squarederror
• n_estimators: 100
• Predicts yield_count
XGBoost Classifier
• Objective: multi:softmax
• num_class: 5
• Class weights: balanced
• Predicts growth_stage
Yield Prediction
(Regression Output)
Growth Stage
(Classification Output)
[Seed Sowing, Germination, Leaf Development,
Head Formation, Harvesting]
SHAP Explainability
• Feature importance
• Model interpretation
• Dependency plots