PROCESSING OPPORTUNITIES FOR BREADFRUIT

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WHY BREADFRUIT? – INCONVENIENT SHORT SHELF LIFE

VITAMINS (Per 100 g)

Pantothenic acid	0.5 mg
Vitamin B1 (thiamine)	0.2 mg
Niacin	0.9 mg
Vitamin B6	0.1 mg
Choline	9.81 mg
Vitamin C	29.1 mg
Vitamin E	0.1 mg

MINERAL CONTENT OF BREADFRUIT (PER 100g)

Phosphorus	30 mg
Calcium	17.1 mg
Sodium	2.0 mg
Potassium	490.3 mg
Iron	0.5 mg
Magnesium	25 mg
Zinc	0.1 mg
Copper	0.13 mg
Manganese	0.11 mg

PROXIMATE ANALYSIS

CARBOHYDRATE	**53% to 76%**
– α 1,4 glucose	**AMYLOSE**
– α 1,4: α1,4,6	**AMYLOPECTIN**
– α 1,2	
FIBRE	**4.9%**
PROTEIN	**1.05% to 1.3%**

TRADITIONAL PROCESSING TECHNIQUES

LACTIC FERMENTATION

- Sea soaked (salt)
- Wrapped in leaves
- Fermented

DRIED

BAKED AND DRIED

SCIENTISTS CANNOT IMPROVE ON NATURE

LIFE AND DEATH PROCESSES

NATURAL MATURATION

COLD STORAGE (EVERY 10 ^{O}C DROP IN TEMPERATURE SLOWS DOWN PROCESSES BY 50%)

LIFE PROCESSES PRODUCE CO_2

PRESERVATION FREEZING

FREEZING IS NOW INSTITUTIONALISED

RECIEPT

INSPECTION

PEELING

DESEEDING AND MANUAL CUTTING

BLAST FREEZING

FROZEN STORAGE < - 18^{o}C


ARMBOY
FROZEN
BREAD FRUIT
500g
Net
FARMBOY

OPPORTUNITIES

FRESH

FRESH CONTROLLED AND MODIFIED ATMOSPHERE (28 days at 8°C)

FROZEN FREE-FLOW

EXTRUSION

LATEX

STARCH / FLOUR

BREADFRUIT FLOUR

1. **THE PROCESS IS EXPENSIVE (Air has to have a relative humidity of less than 40%)**

2. **WHAT ARE YOU GOING TO DO WITH THE FLOUR?**

3. **ADVANTAGE IS 'GLUTEN FREE,' STATUS**

FOR SUSTAINABLE FOOD PROCESSING

1. RAW MATERIAL SUPPLY (FARMERS)

1. TECHNOLOGY EQUIPMENT TO AFFECT CHANGES

2. THE MARKET

MESSAGE

TALK TO EACH OTHER

THERE WILL ALWAYS BE A DEMAND FOR BREADFRUIT IN ONE FORM OR ANOTHER

THANK YOU

MALO

Breadfruit Product Development in Tonga
- Collaborated Project with TUA -

Minoru NISHI (Nishi Trading Co. Ltd)
&
Tokyo University of Agriculture (TUA)

Funded by TUA: 2013.04-2016.3

Members:

	Name	Affiliation/Research Field
Tonga	Minoru NISHI	Nishi Trading Co. Ltd
	Soane PATOLO	MORDI
	Taniela HOPONOA	Live & Learn Environmental Education
	MAFF & other Ministries	
Japan	Tamae SUGIHARA	TUA/Social & livelihood structure
	Hidekazu TOYOHARA	TUA/Use of local botanical resources
	Hiroshi ISHIDA	TUA/Nutritive analysis
	Tomohiro NOGUCHI	TUA/Processing technology
	Kiyoshi TAJIMA	TUA/Appropriate technology and its extension
	Noriaki IWAMOTO	TUA/Rural economy & social business

Background of the research

1 **Corruption of squash boom and economic difficulties**

Expansion of squash production for Japanese market in 1980s: 22,000t in 1991 & 2003 22,500t (55 % of total export) → only 1,000t in 2000

← Competition with Mexican squash

Long storage of squash in Hokkaido

Land development = destruction of agro-forestry

Poor production

2 **Health problems caused by imported foods (cheap SIPI & canned corn beef**

3 **Diminishing of local resources: Dependent on imported foods and limited us**

To solve the above challenges by:

①Focusing on BF (typical type of local resources in South Pacific islands)

② Finding new processing technology and marketing channels

Research structure, topics and prospected results

Structure

Breadfruit
(*Artocarpus altilis*.)

Processing
(Powdering)

Marketing
(Social business)

Topics

①Traditional use of native plant resources (BF) and its changing process

②Farming systems and livelihood structure of local people

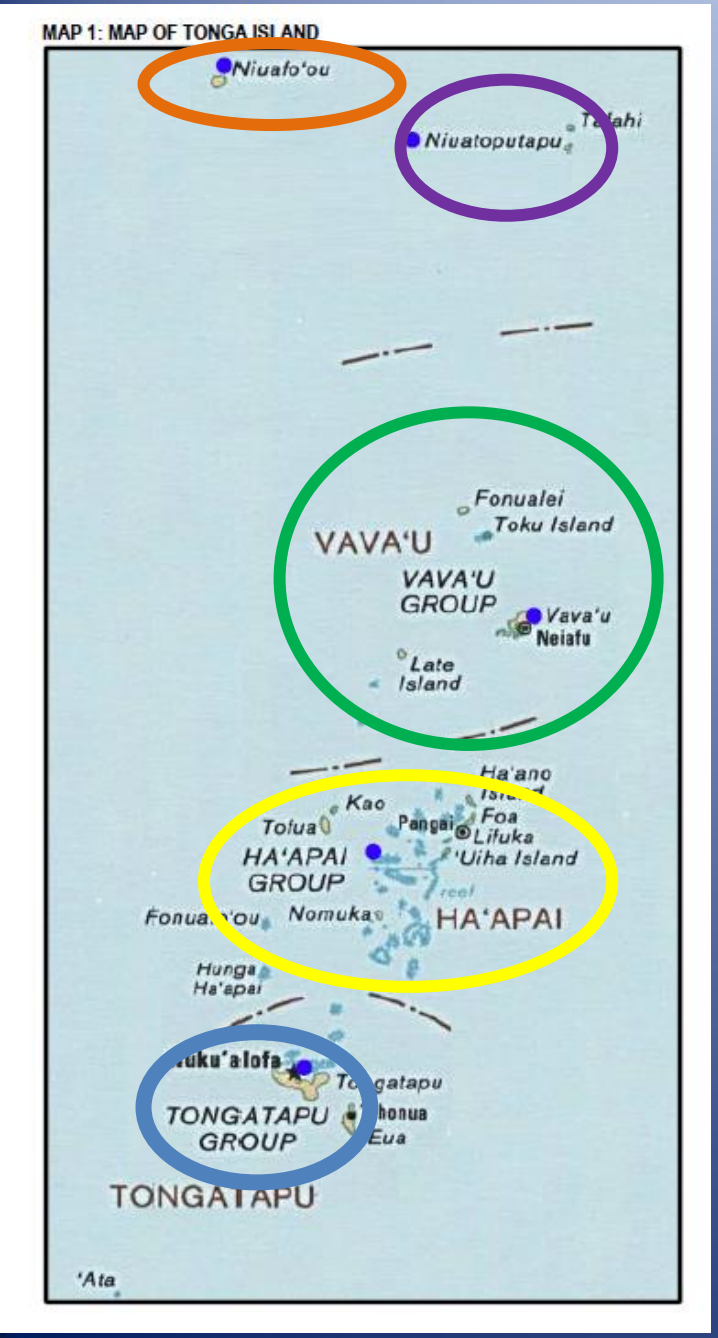
③Nutritive usefulness of BF

④New processing technology for drying & powdering of BF

Results

① Increase of self-sufficiency rate of foods by substituting imported wheat flour
② New exportable products other than squash
③ Recovery of identity as native pacific islanders by consuming traditional foods

Resources Survey

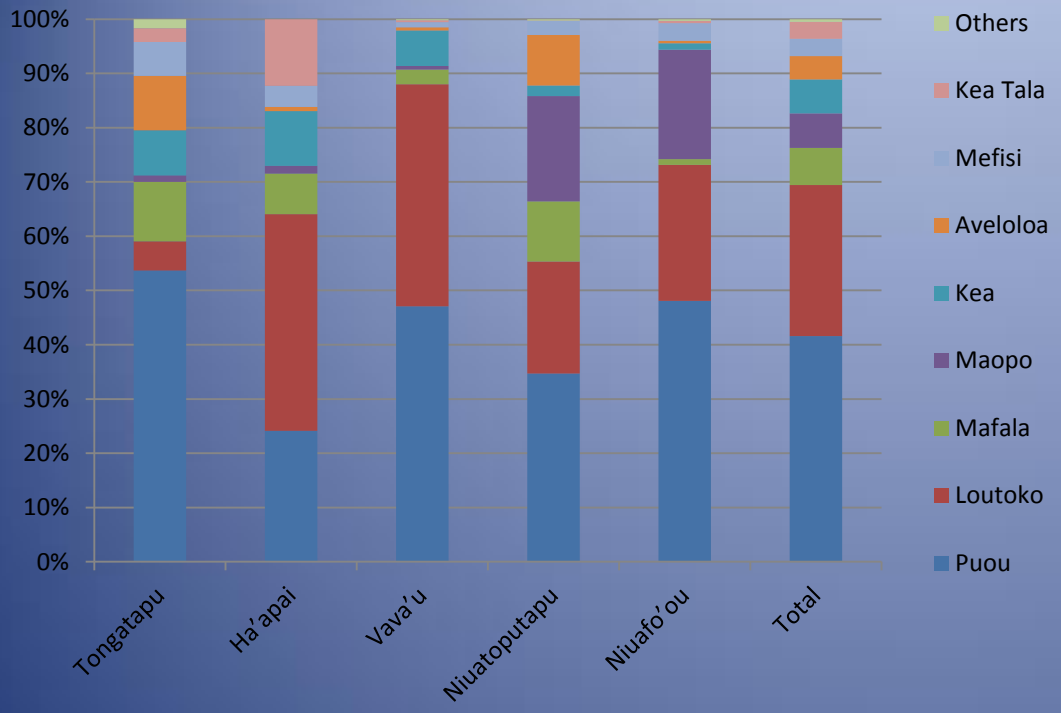


Characteristics of respondents

Name of island	No. of villages/communities	No. of samples	Age of HH	No. of family member
Tongatapu	3	325	53.9	6.0
Ha' apai	6	161	50.8	5.2
Vava' u	11	245	54.7	4.6
Niuatoputapu	4	177	48.1	4.0
Niuafo' ou	7	86	53.4	4.7
Total	31	994	52.5	5.1

Source: Survey in 2013.

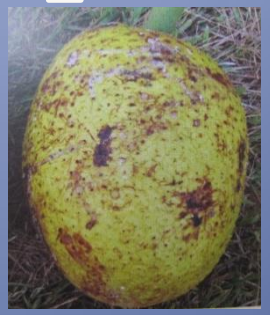
Varieties of BF



Source: Survey in 2013.

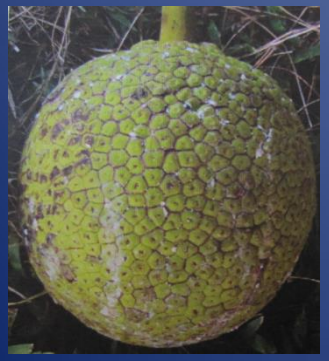
Kea Tala

Mefisi



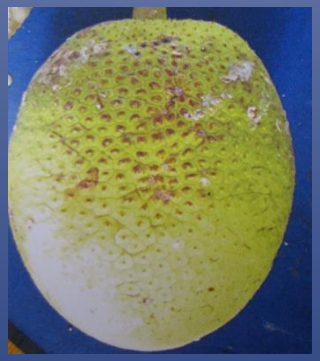
Aveloloa

Puou



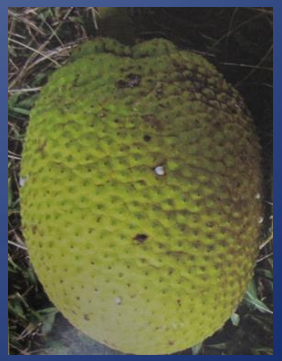
Loutoko

Mafala

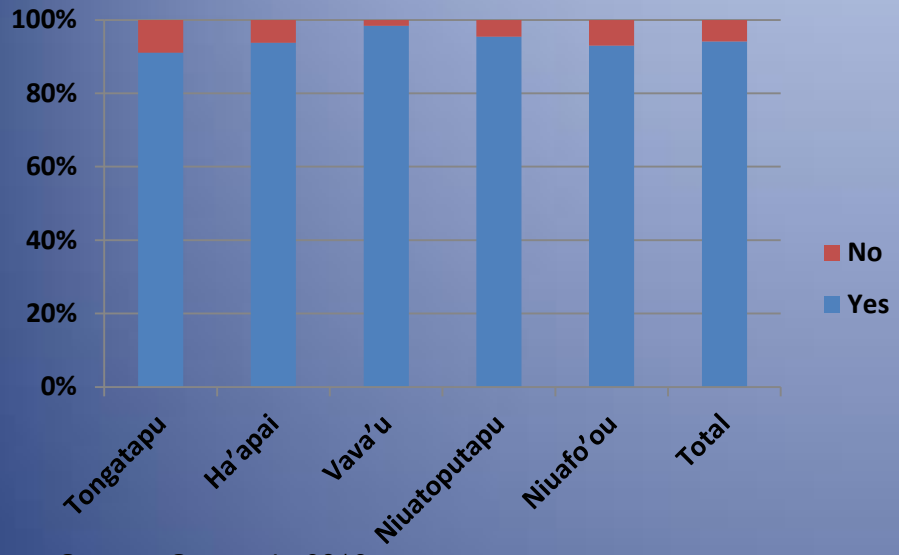


Maopo

Kea



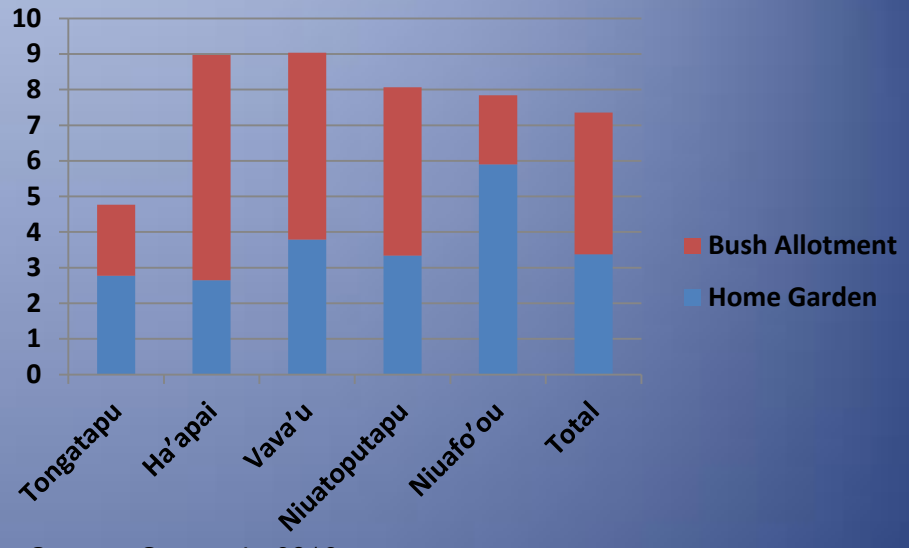
Planting of BF



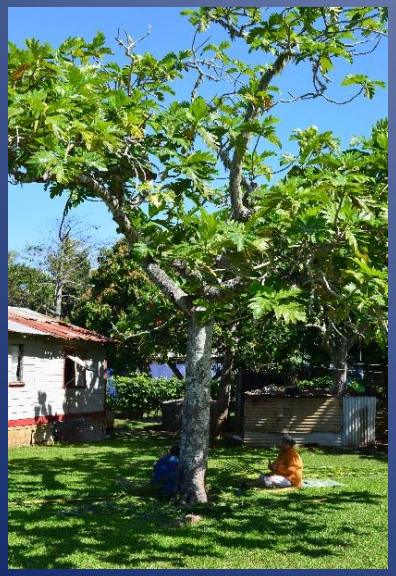
Source: Survey in 2013.

Number of BF

(plants/respondents)



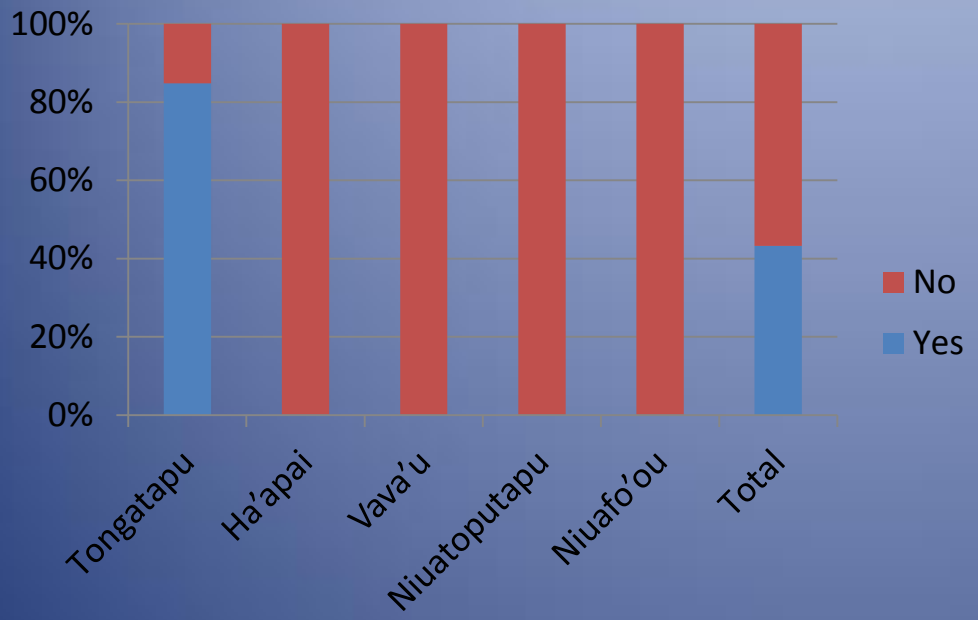
Source: Survey in 2013.



【Home Garden】

【Bush Allotment】

Sales of BF



Source: Survey in 2013.

Tongatapu: 80 % households sell BF

Outer islands: 100 % for self consumption and 70 % of products are wasted

TALAMAHU Market (Tongatapu)

Nutritious Analysis

(g/100g)

	Water	Protein	Fat	Carbohydrate	Ash
Kea	11.3	2.6	1.1	82.1	2.9
Kea Tala	11.0	3.3	0.8	81.2	3.7
Puou	9.8	2.6	1.2	83.9	2.5
Maopo	10.8	2.4	1.1	82.4	3.3
Mafala	12.2	3.1	1.7	80.0	3.0
Aveloloa	11.0	2.6	1.1	82.7	2.6
Mefisi (edible portion)	8.7	0.3	1.5	85.1	3.4
Loutoko (edible portion)	8.4	0.4	3.7	84.1	3.4
Mefisi (core)	8.9	9.6	2.7	73.9	5.6
Loutoko (core)	9.9	7.9	2.5	73.5	6.2

Minerals

(mg/100g)

	Na	K	Ca	Mg	P	Fe	Zn	Cu	Mn
Kea	18	926	30	102	38	1.2	0.2	0.17	0.24
Kea Tala	2	1247	33	104	49	0.5	0.2	0.15	0.21
Puou	23	554	51	91	34	0.8	0.1	0.07	0.08
Maopo	6	1670	28	85	45	1.1	0.2	0.01	0.16
Mafala	22	2166	51	75	38	1.1	0.2	0.01	0.21
Aveloloa	11	1079	41	90	36	1.0	0.2	0.08	0.19
Mefisi (edible portion)	1	1043	57	86	59	1.2	0.2	0.18	0.25
Loutoko (edible portion)	0	1035	62	95	67	1.0	0.2	0.14	0.14
Mefisi (core)	40	901	317	109	23	3.1	1.2	0.96	0.42
Loutoko (core)	29	1000	298	62	21	1.8	0.6	0.88	0.17

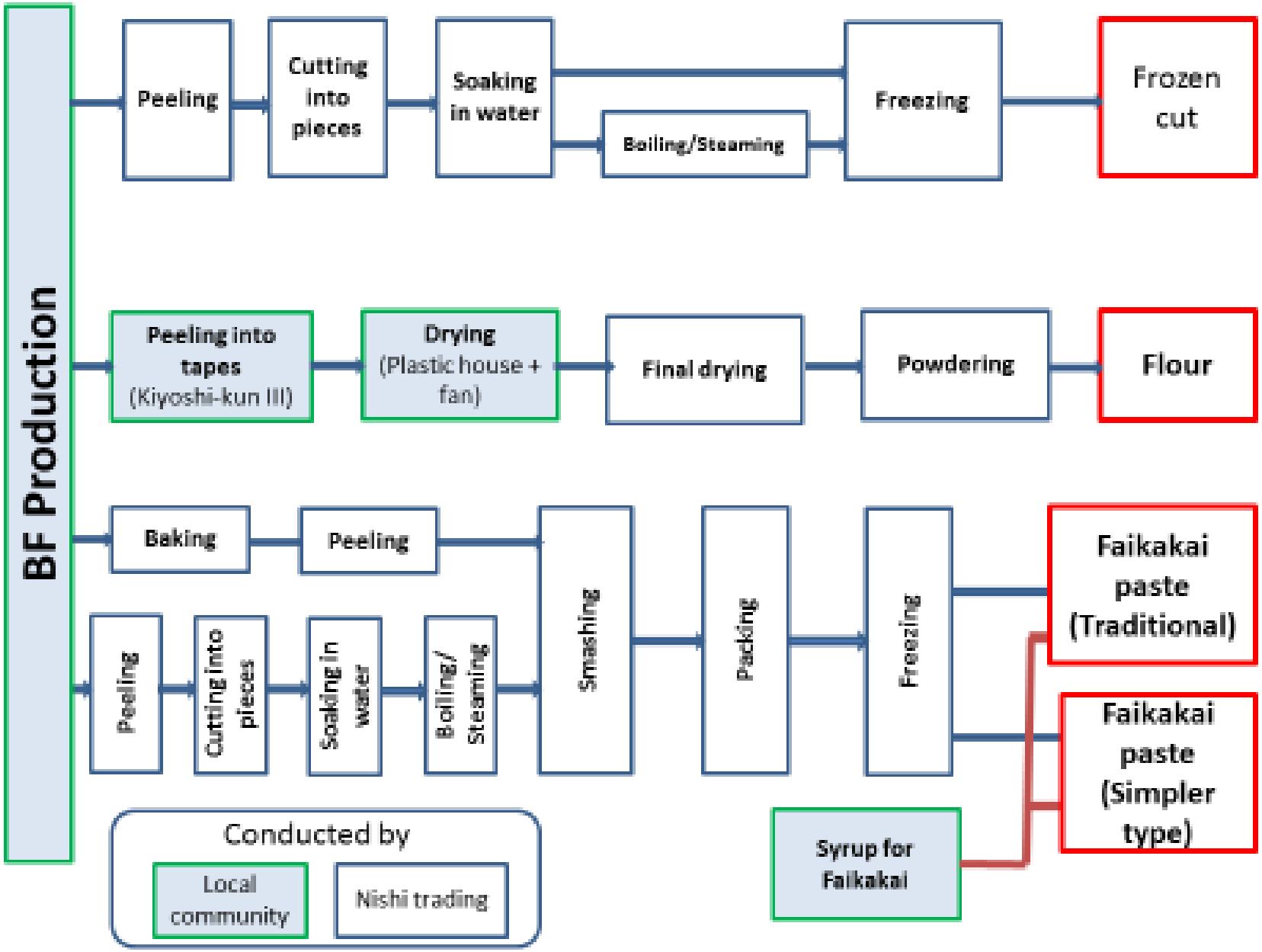
Summary

1. No big difference between varieties

2. Nutritious contents:
   (1) Mainly in Carbohydrate
   (2) Protein: Core portion contains over 10 times higher protein than edible portion
   → % of protein will be changed by removal % of core portion
   (3) Rich in minerals

3. Peeling of skin and core removal should be constant in order to get constant quality of BF flour

Manufacturing Process of Main Products



BF

Baking

Peeling

Steaming

Peeling

Mashing

Smoking

Added Sugar

Heating

Bottling

Sealing

Faikakai with lolo

Coconut

Scraping

Pressing

Coconut milk

Heating

Lolo

Bottling

Sealing

Bottled Lolo

Sugar cane

Sugar

Conducted by

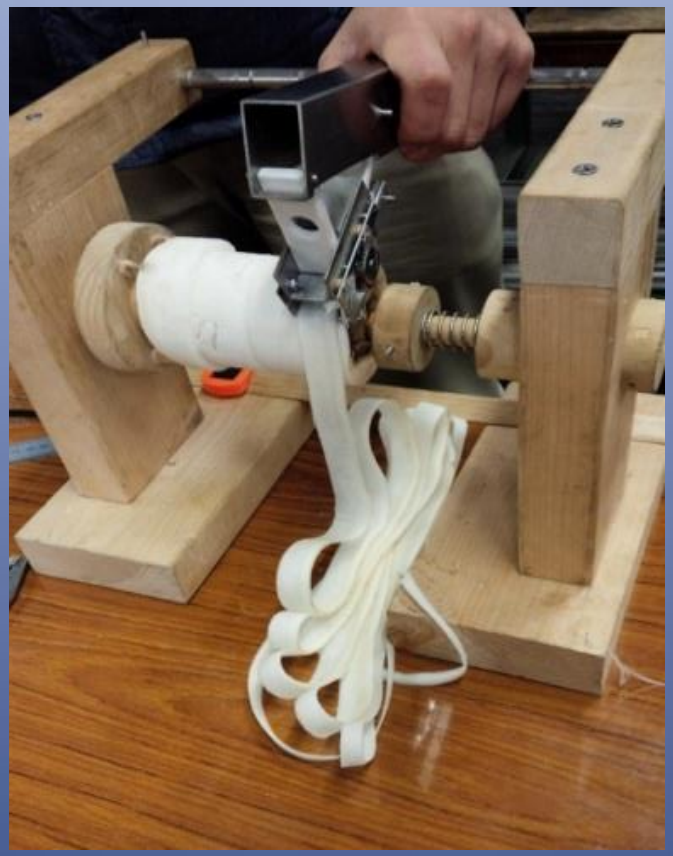
Local community

Nishi trading

Processing of BF Flour

1. Peeling and slicing by Kiyoshi-kun
2. Soaking in water
3. Drying by sunshine and fan (solar energy)
4. Milling

1. Peeling & Slicing

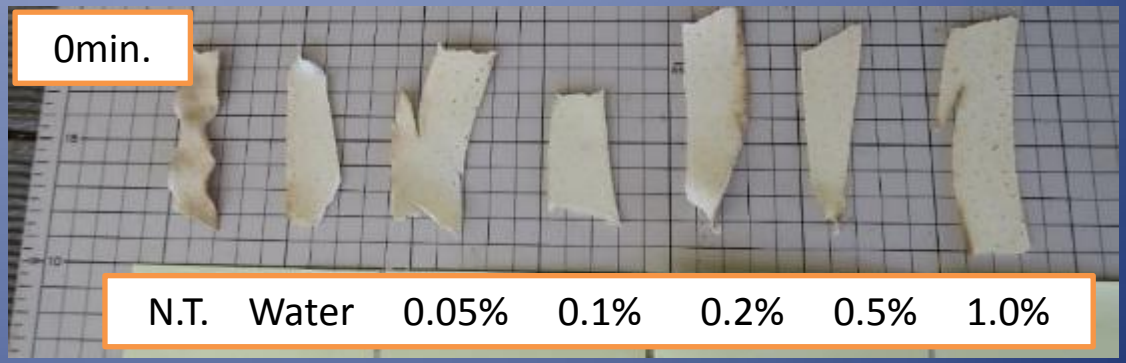


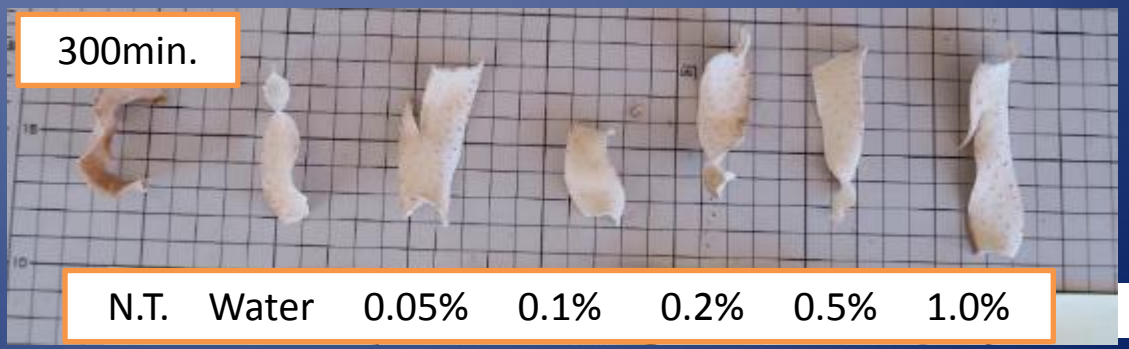
2. Soaking

Effect of salt concentration on BF color.

Soaked for 60 min.

Dried





3. Drying

Change in color during the drying process

Just after soaking （Drying start)

N.T. Water Treatment 1% NaCl Treatment

After 4 hours drying

N.T. Water Treatment 1% NaCl Treatment

4. Milling

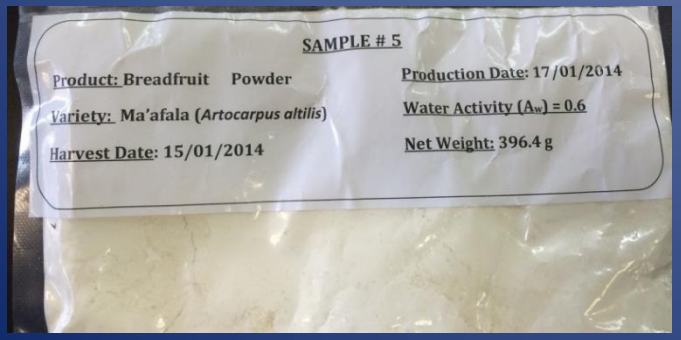
Product 1: Bread

Bread making 1. Wheat Flour with Rice flour or BF flour

	Rice	BF
Wheat Flour	220	220
Rice Flour	30	-
BF Flour	-	30
Honey	40	40
Whole Milk	180	180
Butter	20	20
Salt	4	4
Dry Yeast	3	3

Panasonic SD-BMS105

BF Sample: Mafala(2014/1/15)



With Rice Flour With BF Flour

Weight	413.5g	423.5g
High	16.1cm	15.4cm

Bread making 2. Gluten Free Bread with BF Flour

	g
Corn Starch	100
Rice Flour (C3)	100
BF Flour	40
Sugar	30
Olive oil	6
Salt	3
Dry Yeast	5
Water	225

Panasonic SD-BMS105

Product 2: *Karukan (Japanese Traditional cake)*

	g
Rice Flour	30
BF Flour	10
Cocoa	20
Baking Powder	2.5
Sugar	40
Egg White	25
Yam	80
Water	75

Product 3: Faakakai
(Breadfruit Dumplings in Coconut Caramel Sauce)

http://www.aucklandnz.com/pasifika/pasifika-festival-food-recipes

Processing of frozen Faakakai






With sugar

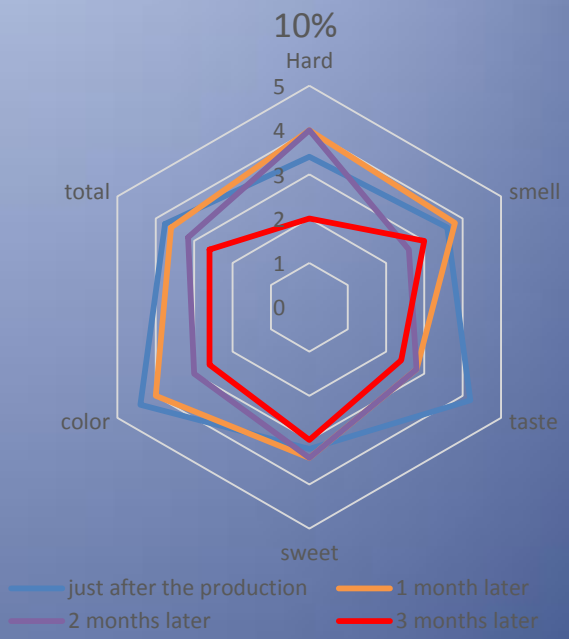
Freezing

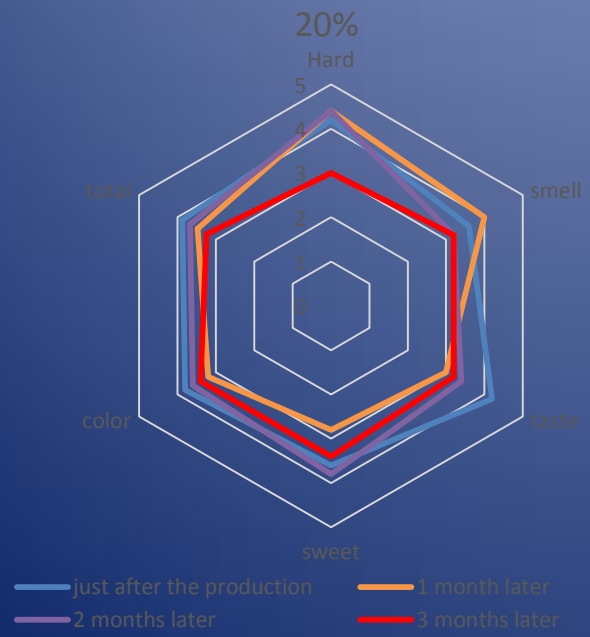
Variety: Kea, Loutoko
A:control
B:FKK 190g + Sugar 30g (13.6%)
C:FKK 190g + Sugar 40g (17.4%)
Data:2015/3/27

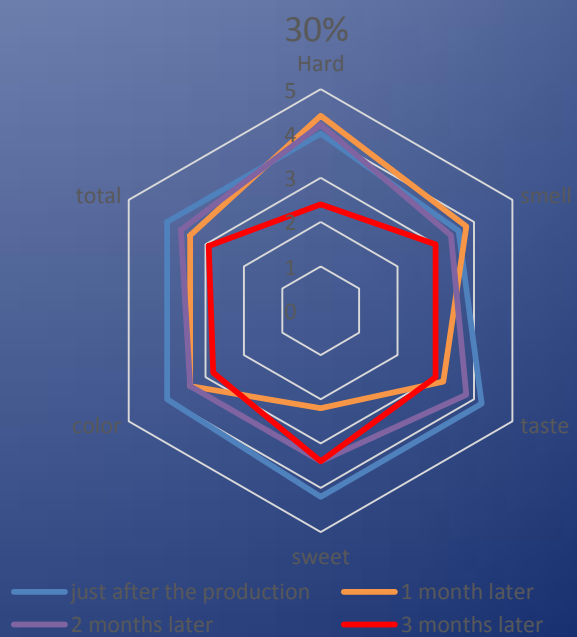
Puou

Results of Sensory Test

Ex. I

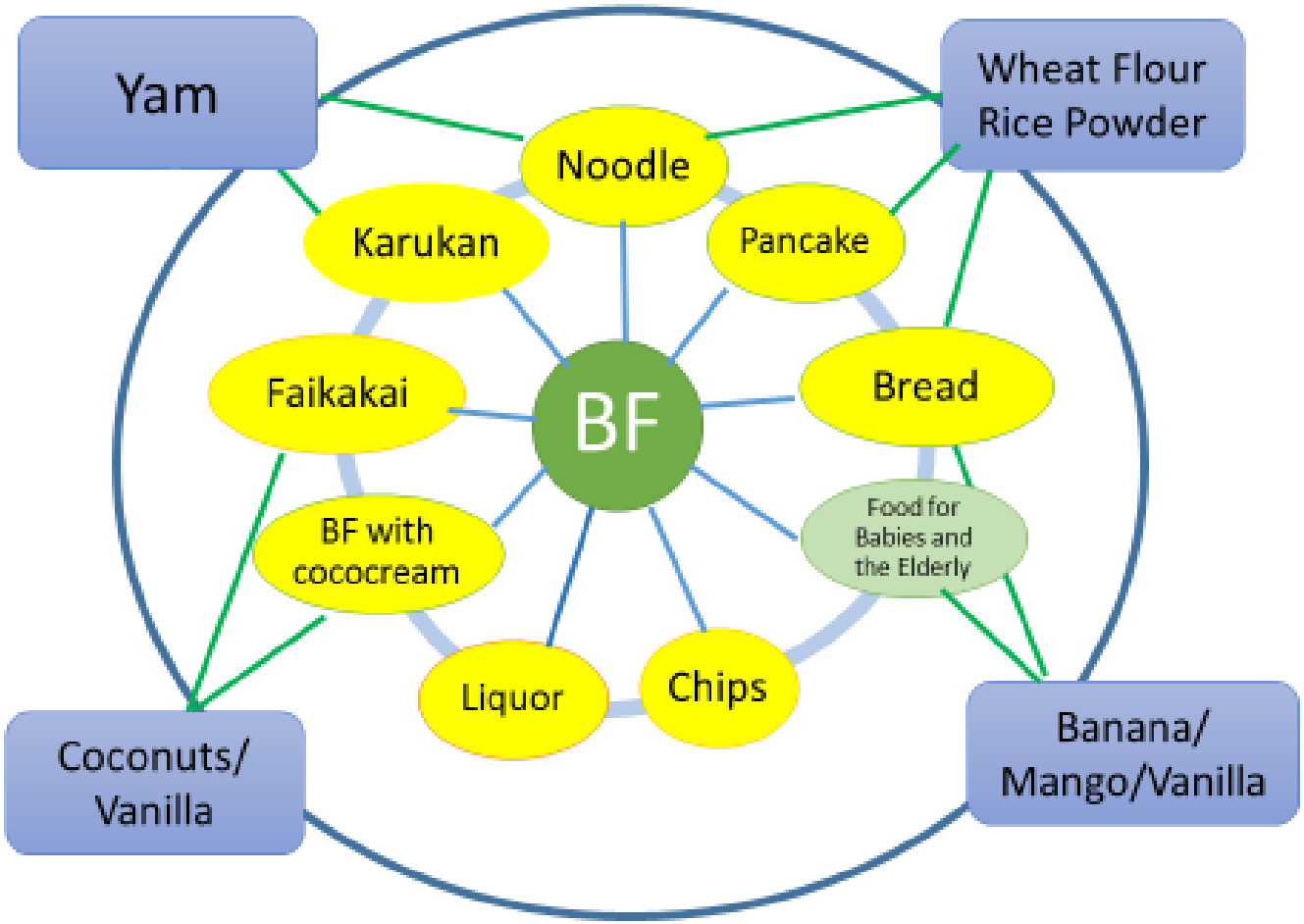






Promising Products of BF & Local Resources

- Liquid fertilizer
- Special pork fed by BF
- Natural glue by latex
- Wrapping materials by leaves
- Etc. ……



: Already experimented

Value Chaine and Community Business of Mei (Tongan Breadfruits)

Midstream

NISHI TRADING

- FROZEN → CUT FRUITS → P
- POWDER → BREAD → PANCAKE → NZ → P → T
- COOKED → Retort pack → Bottling → Vacuumed Pack → P
- Liquors → Beer → T
- Liquid Fertilizer → T

Upstream

Community Business

Downstream

Local Resource

- ←Traditional Wisdom
- Awareness campaign
  At School・Univ
  At Home
- Afforestation
- Work Book/DVD
- Tongan Food Menu Book
- Recovery of identity as native pacific islanders

New Products

- ←Scientific Technology
- WORK SHOPS
- New exportable products
- self-sufficiency rate of foods by substituting imported wheat flour

Collaboration with Local Communities: Learning from Local Knowledge

Collaboration with Local Communities: Demonstration of New Products

Multi-Cultivar Tree Demonstration Plot

Global Mana

- Food – Energy - Water

Global Mana

- Engineering solutions for standardized production of breadfruit fruit into flour.

QC Engineering

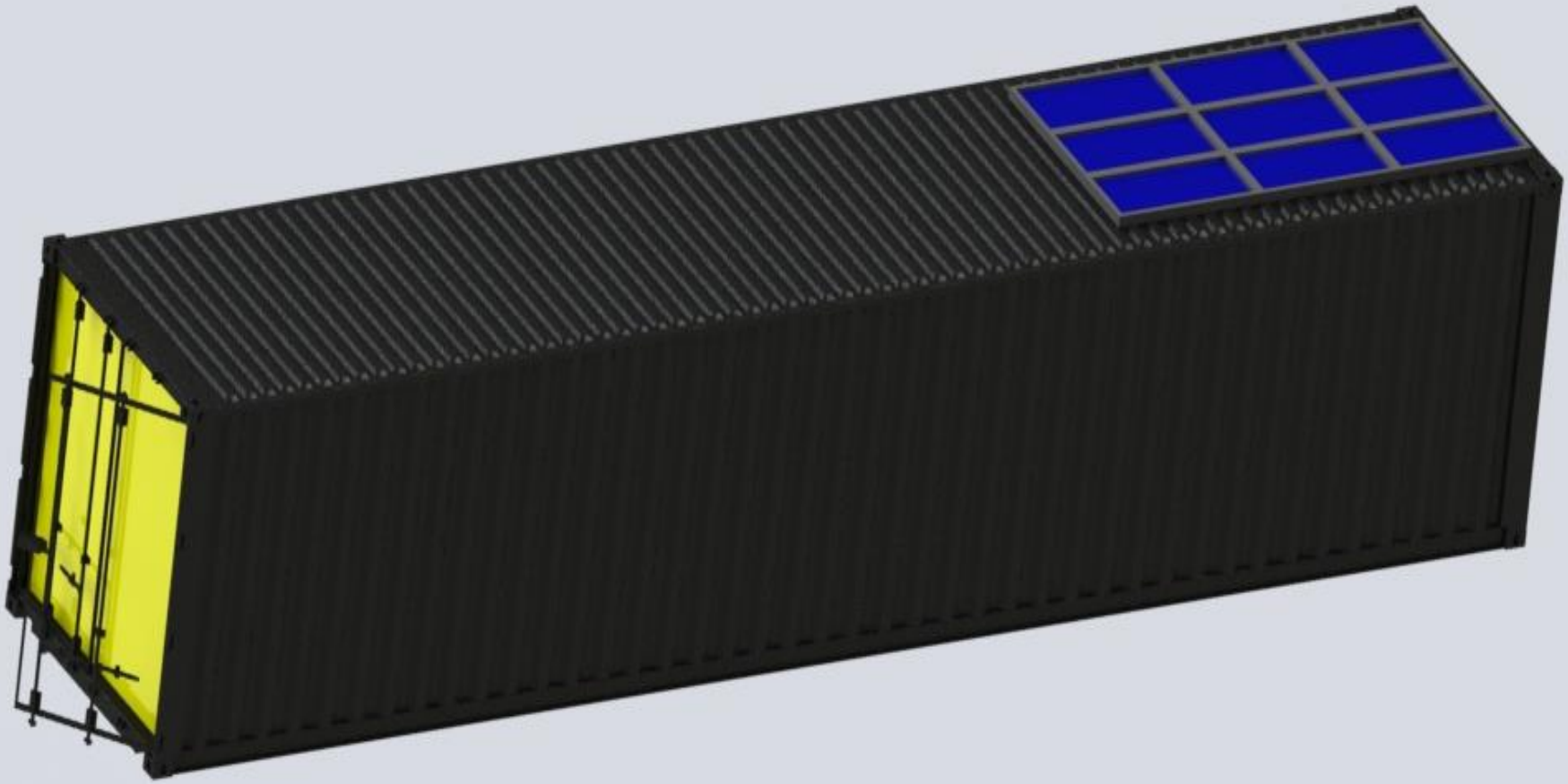
1. Eliminate Variation in Picking
2. Eliminate Variation in Cutting
3. Eliminate Variation in Drying
4. Eliminate Variation in Milling
5. QC Checks and Guidelines

- Importance of group compliance

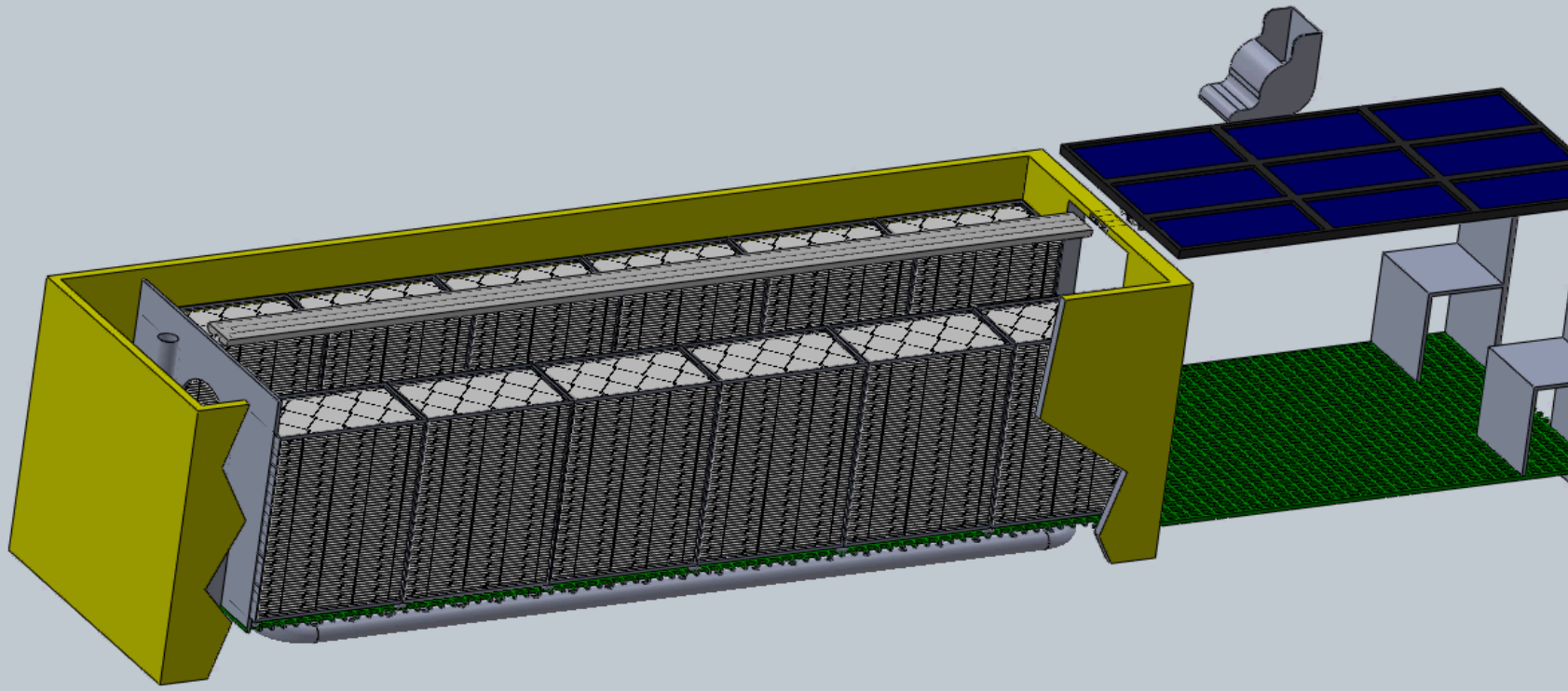
Global Mana Equipment

1. Pickers
2. Ripening sensors (upcoming)
3. Peelers
4. Slicers
5. Small electrical dryer
6. Small solar heat dryer
7. **Container Dryer system**

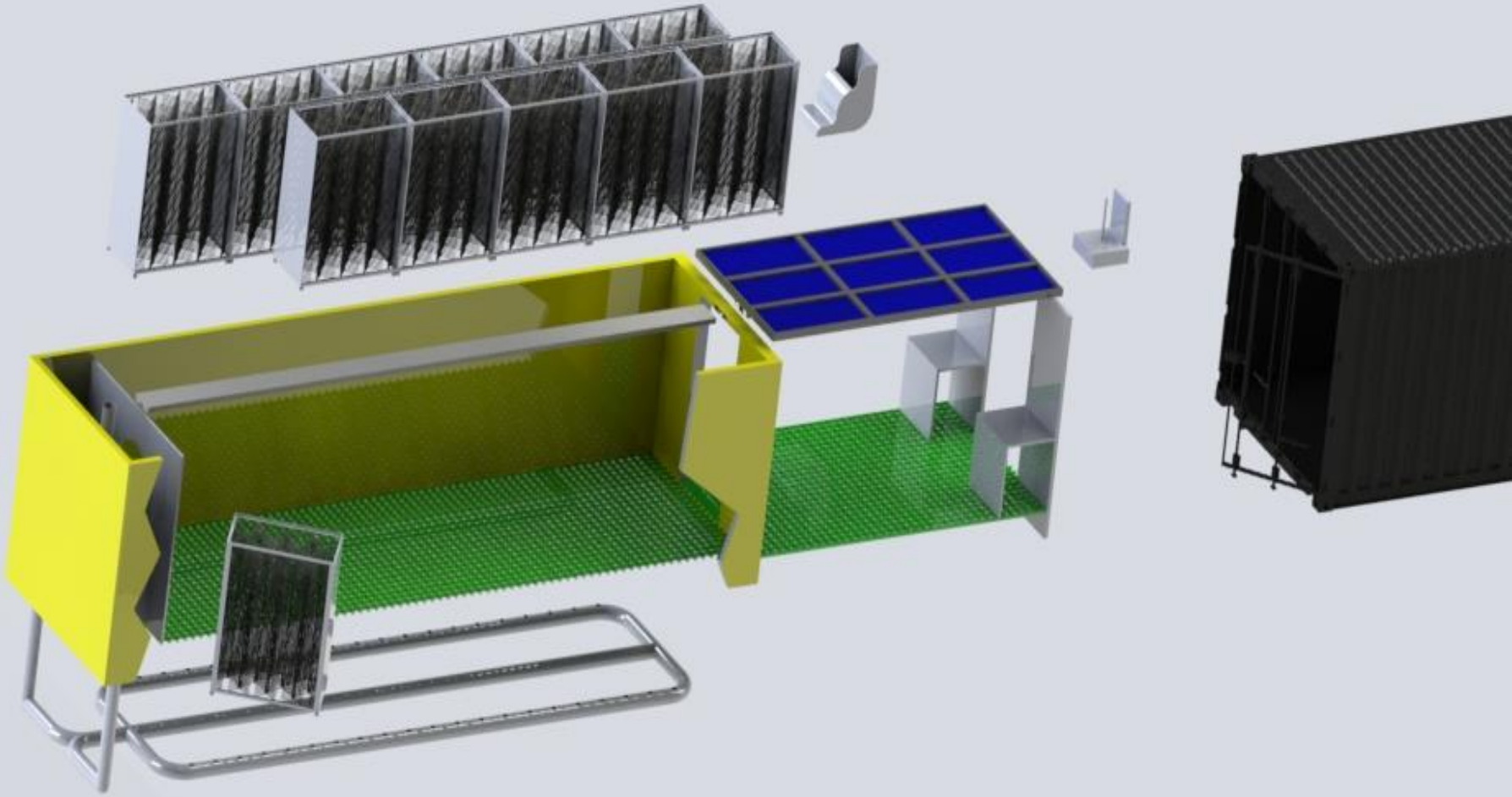
40' HQ Container Dryer



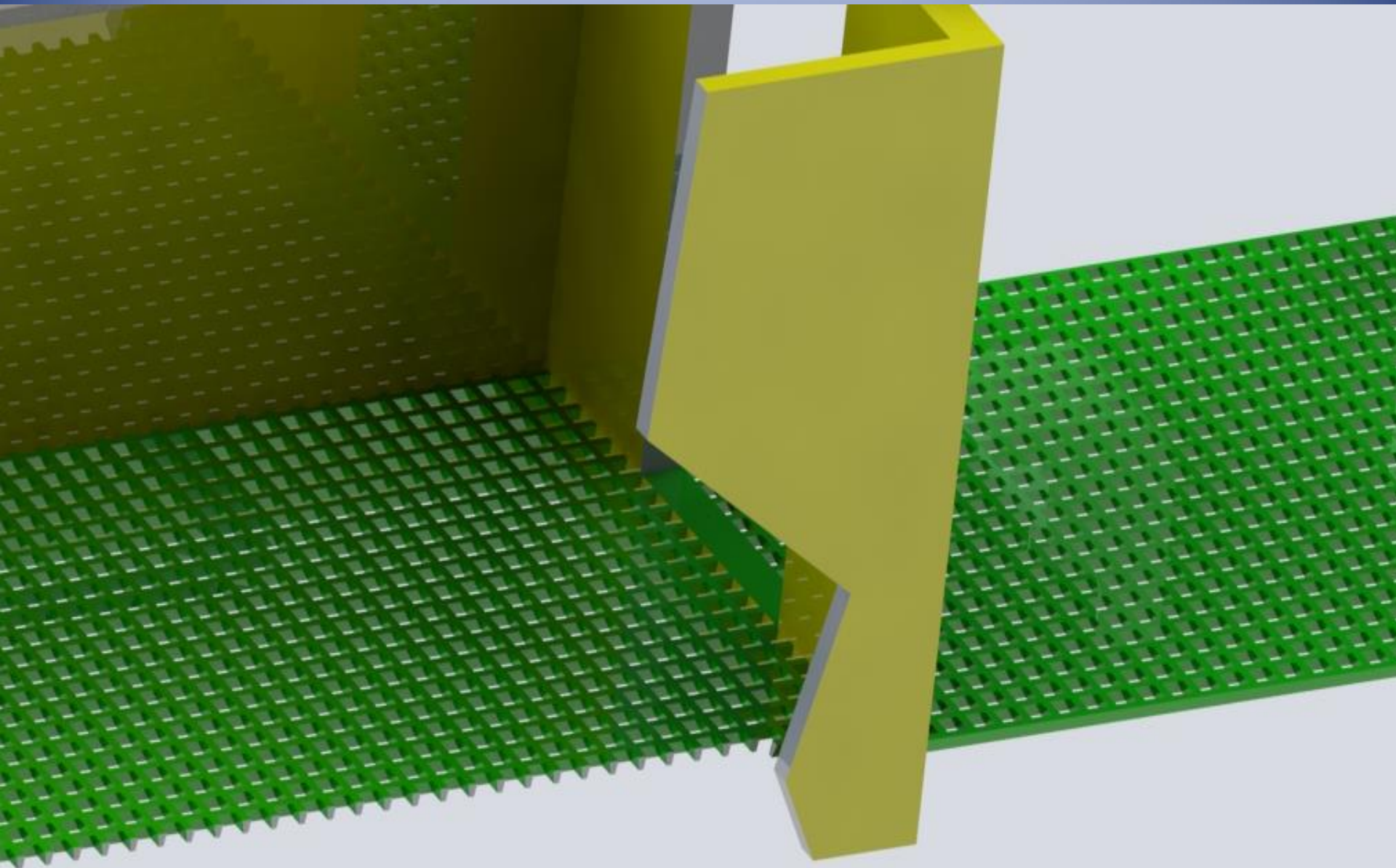
Assembly



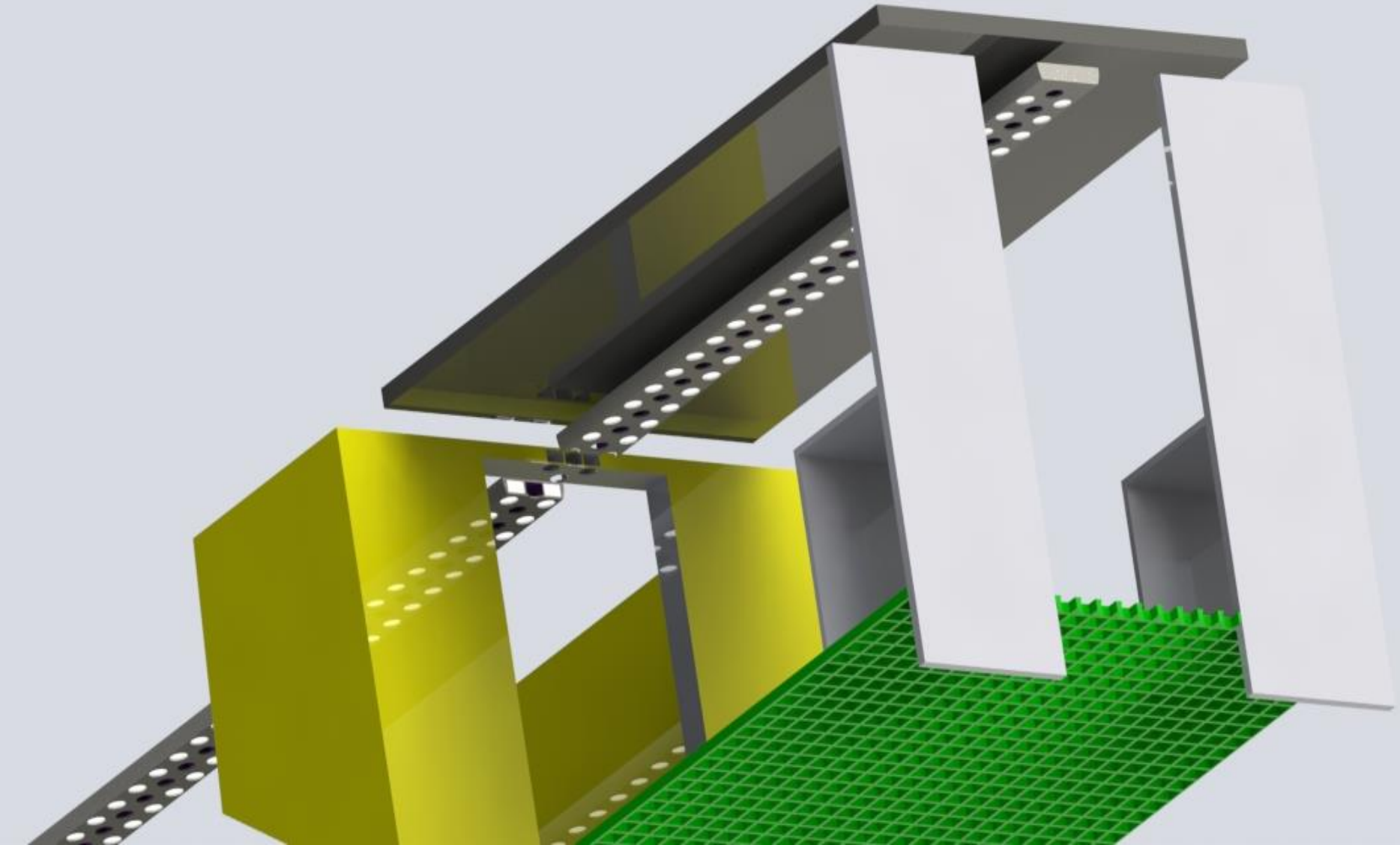
Exploded View



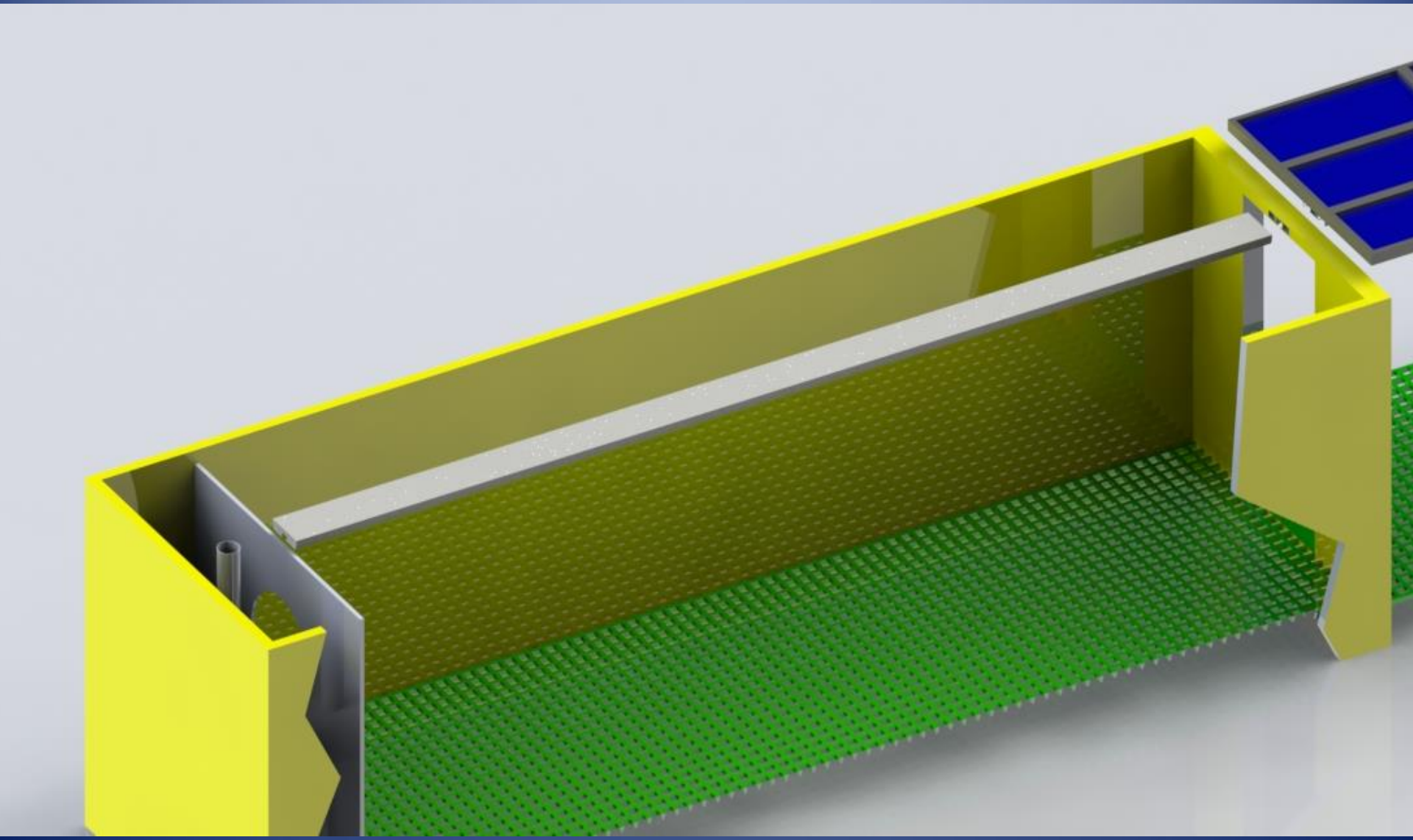
Clean and Washable



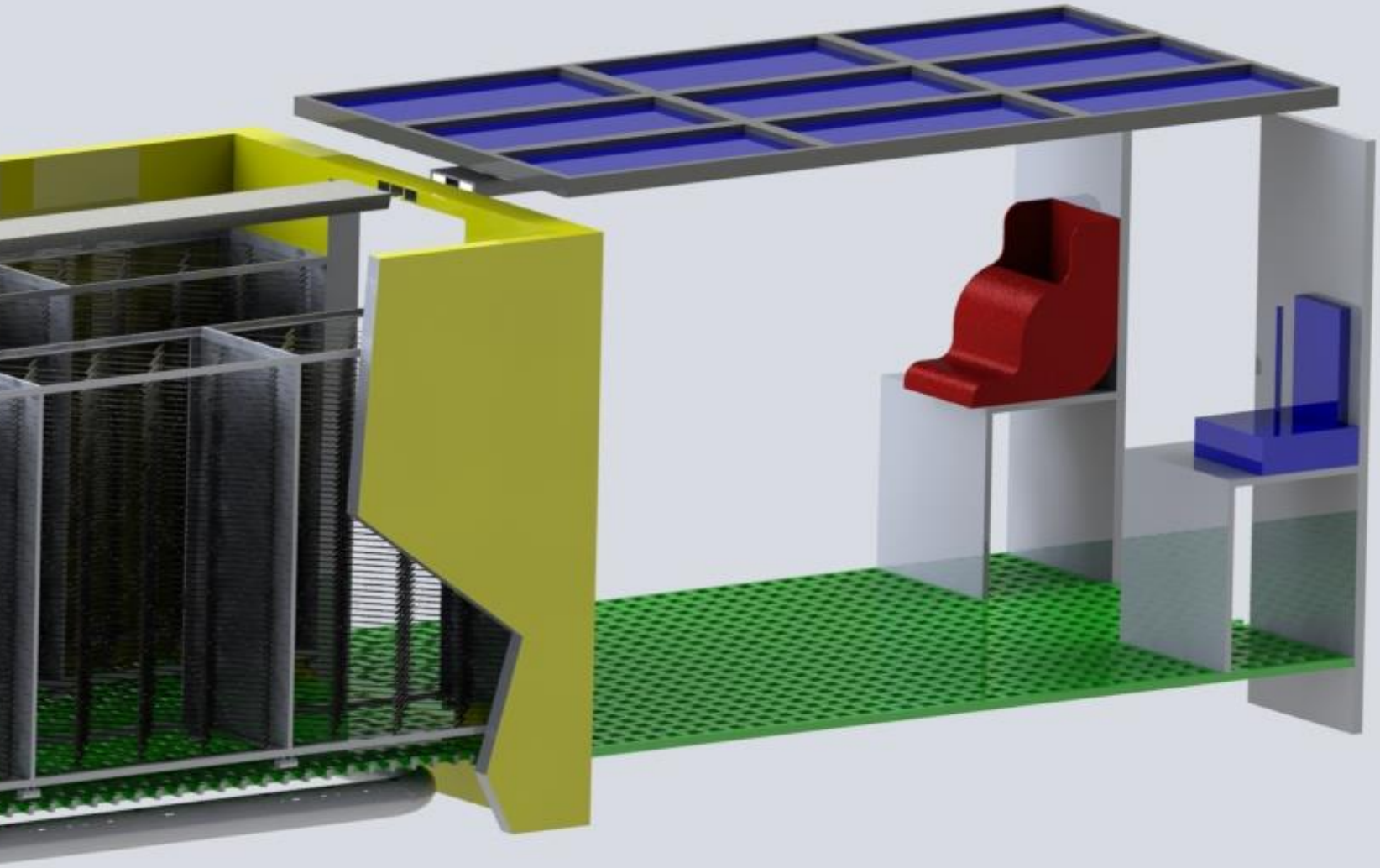
Lights - Cleaning



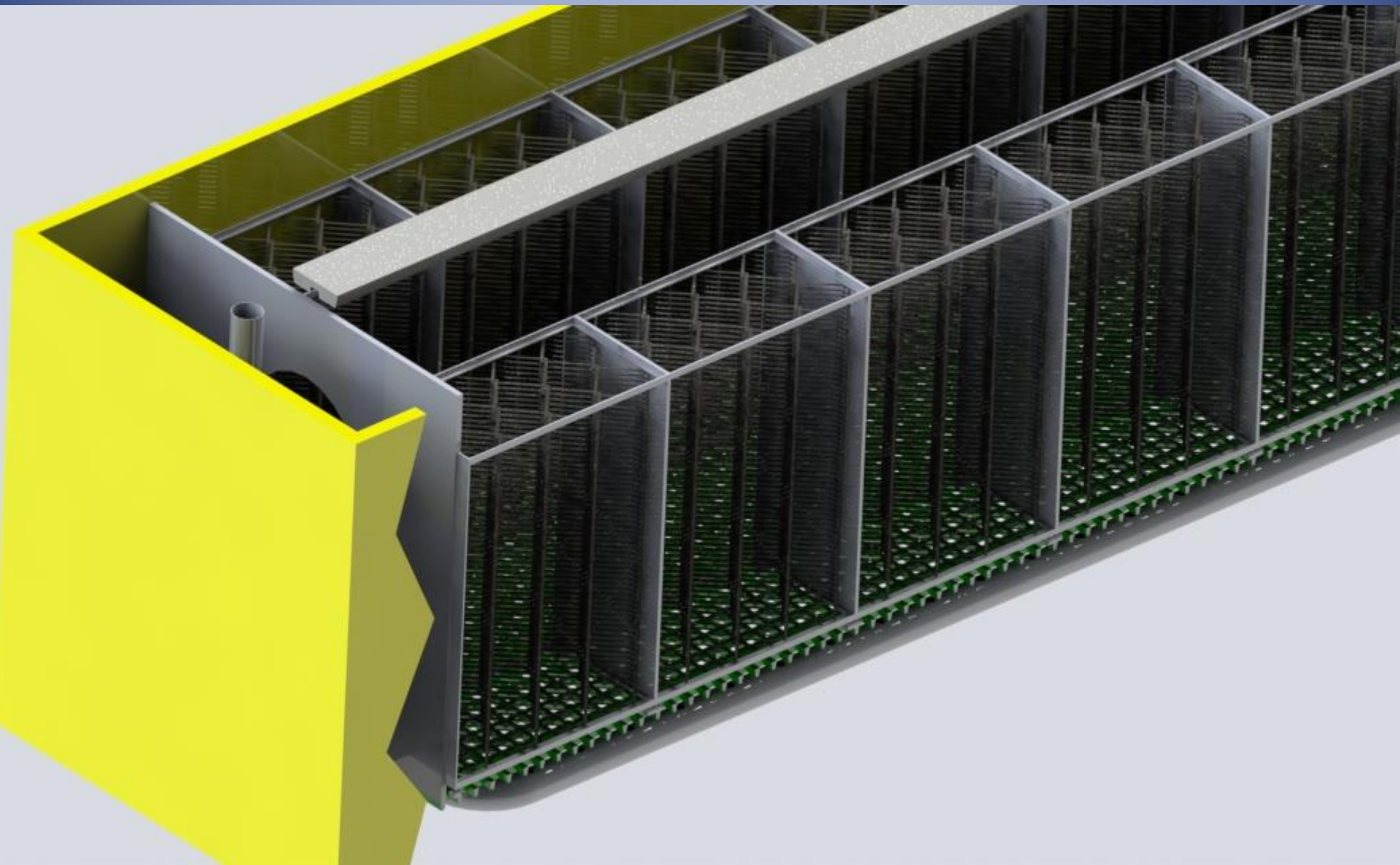
Insulation



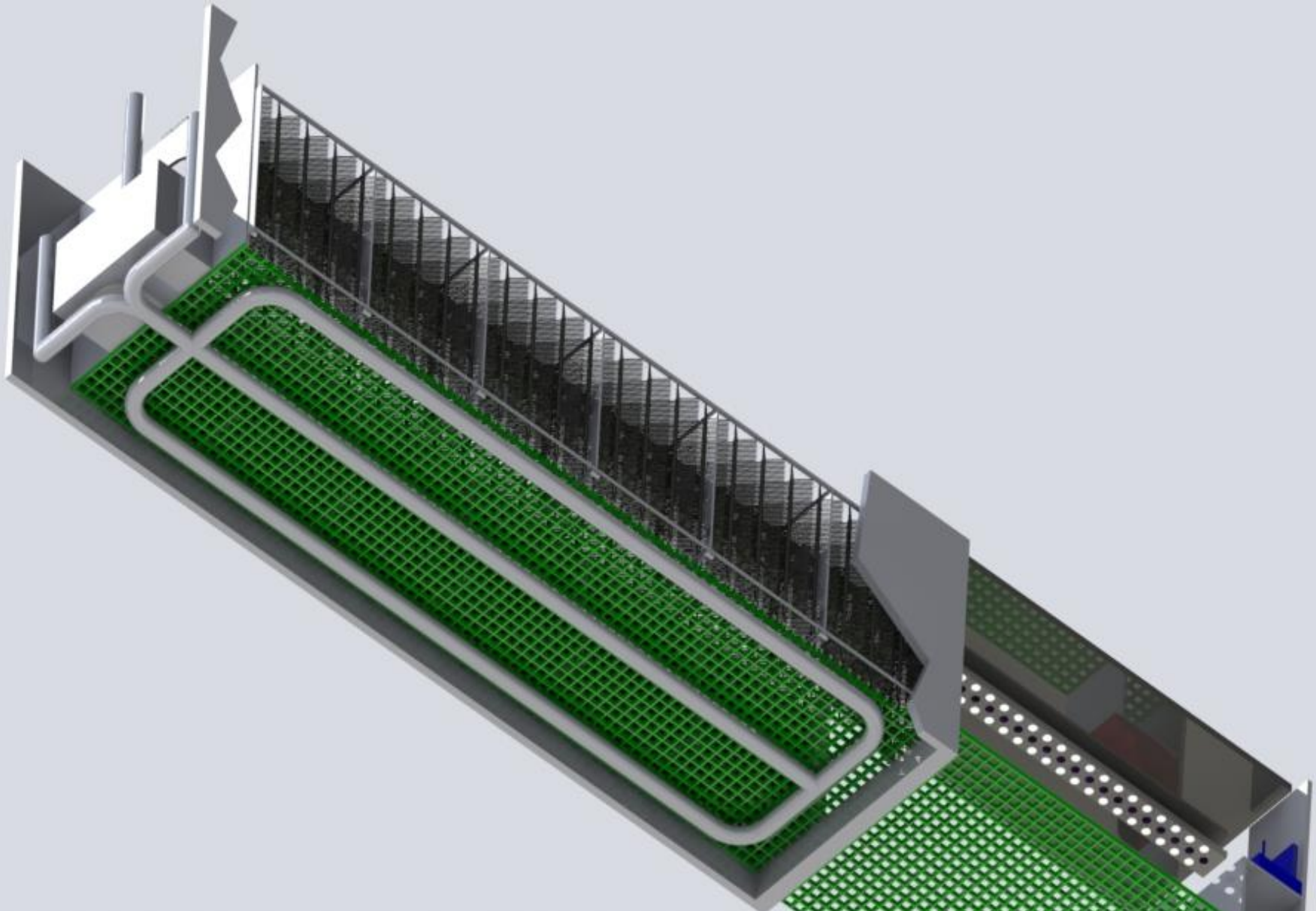
Prep Area



Racks



Heat Distribution



Technical Considerations on Heat and Humidity

Sources of Heat

- Solar Electrical Power
- Solar Heat Power
- Clean Burn Oven
- Emergency Electrical Power

- Equalizer – outside air pump

Technical Considerations on Heat and Humidity

Constants

- Relationship between heat and humidity
- Benefit of Island Production – almost constant heat and almost constant humidity
- Computerized heating systems can equalize the drying temperatures and humidity making it constant each time
- Heat curve computer managed

Technical Considerations on Heat and Humidity

Variables

- Variability in the system occurs based on the amount of breadfruit added into the dryer each time – more breadfruit means more heat absorbing mass and more liquid to extract.
- System could be calibrated by weight.
- Best method is calibration by determining how much heat is absorbed and adjusting the system based on heat absorption measured size.

Technical Considerations on Heat and Humidity

Solutions for Variables

In a repeatable closed system our technology will be designed to obtain the same results each and every time without human intervention standardizing quality by standardizing the output.

Costs

Research has been funded by Global Mana

Components built at low costs

Costs TBD

Profitability model is 0% - cost will be our cost, our focus is volume, so the cost for machinery is our cost for all participating with us

Global Mana

- Engineering solutions for standardized production of breadfruit fruit into flour.