

EAAP 2013 - Nantes

A 3D-serious game for teaching the environmental sustainability of pig farming systems

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Context

- Animal production in the world (FAO, 2006)
 - Animal production has a significant contribution to the environmental impacts at world level
 - Consumption of animal products is expected to increase by almost 100%
 - ⇒ Necessity to reduce the impact per unit product by more than 50%
- Different strategies for improvement
 - Improvement of animal's efficiency
 - Reduction of emissions from manure
 - Adaptation of livestock farming systems...
 - ⇒ Different approaches at different scales : animal, feed, housing, manure management...

The environmental impact of animal production

- Complex to evaluate
 - Fluxes or concentrations : nitrates, ammonia, phosphorus, energy, water
 - Aggregated impacts : eutrophication, acidification, global warming, use of non renewable resources
 - Negative / Positive (biodiversity, carbon storage, land use...)
- Can be improved in different ways
 - Design of the whole system
 - Animal density per ha, recycling of nutrients...
 - Improvement of production process and practices
 - Animal performance, animal feeding and housing, manure management...

Models available in



Different models available in the literature

- But they are difficult to understand and to teach
 - Complexity : too many equations and interactions...
 - Lack of realism : only numbers, no pig, no building, no manure...
 - Lack of attractiveness for the students : too conceptual & abstractive ...

⇒ Develop a **3D serious** game using a **pig farm simulator** in order to facilitate the learning process

Objective : change interface from this !

Model_LCA_1806 Conventiennel FR.xls [Mode de compatibilité] - Microsoft Excel

FichierAccueilInsertionMise en pageFormulesDonnéesRévisionAffichageDéveloppeurAcrobat

Coller

PoliceAlignementNombreStyle

Pourcentage

Mise en forme conditionnelleMettre sous forme de tableauStyles de cellules

InsérerSupprimerFormat

Trier et Rechercher et filtrer sélectionnerÉdition

Presse-papiers

G32

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1																
2	IDENTIFICATION															
3	Country				France		In green : calculated cells				1 sow =	3136	kg LW/year			
4	System				FR-Conventiennel		In yellow : cells to be filled in				1000 kg carcass =	0,32	sows			
5	Herd n° or "average"				average											
6																
7	FEEDING															
8											MJ/kg	g/kg	g/kg	g/kg	ppm	ppm
9	One Sow			27,8	piglets/sow/y	7,38	kg at wean.	Feed/sowly	% total	kg/year	ME	CP	tot P	K	Cu	Zn
10	Weight at culling			240	kg			Gestation	71%	945	12,2	133	4,7	8,0	16	76
11	Replacement rate			47%	%/year			Lactation	29%	385	13,3	159	4,9	7,0	17	74
12								total		1330	12,5	140,5	4,8	7,7	16	75
13									%total	kg/pig produced	ME	CP	tot P	K	Cu	Zn
14	One Piglet	7,38 to	31,9	kg live W	1,70	kg/kg FCR	Phase 1	13%		5,5	14,7	191	5,9	9,0	155	119
15	Mortality rate						Phase 2	51%		21,2	13,4	178	5,2	8,9	156	89
16	post weaning (%)			1,4%			Phase 3	36%		15,0	13,4	169	4,8	8,1	154	90
17							total			41,7	13,6	176	5,1	8,6	154,9	93,5
18																
19								%total	kg/pig produced	ME	CP	tot P	K	Cu	Zn	
20	One Slaughter pig	31,9 to	115,3	kg live W	2,84	kg/kg FCR	Starter	8%		18	13,0	169	4,8	8,0	154	87
21	Age at slaughter			180	days		Growing	36%		85	13,0	160	4,2	8,0	19	59
22	Carcass weight			87,9	kg		Finishing	57%		134	13,0	146	4,2	7,4	18	59
23	Carcass lean meat content			60,2	kg/100kg		total			237	13,0	153	4,2	7,7	28,3	61,0
24	Mortality rate fattening (%)			2,7%												
25																
26	HOUSING & SLURRY MANAGEMENT															
27					Full slats	Partial slats	Deep Litter	Outdoor	Animal/ha	Rotation				Crop yield T		
28														DM/ha/year		
29	Pregnant sows				100%											
30	Lactating sows				100%											
31	Post-Weaning				100%											
32	Fattening				100%											
33																
34								Storage								
35																
36	Slurry				Evacuation	type	duration, d	Cover	Treatment	% treated	Spreading	Slurry				
37	Deep litter				each batch	tank	180	no	aerobic	10%	injection	Transport, km				
38					normal				none			10				
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FarmEmiss_SowsEmiss_WeanersEmiss_FatteningFeedsLCA_calculationLCA_1000kgLCA_Q1

Prêt100%

... to this !



Approach used to develop the tool

- Build a multidisciplinary team
 - Scientists and engineers from research & development (French network “*Animal production and environment*”)
 - Teachers in animal science and agriculture
 - Specialists in the use of new e-technologies for teaching & learning
 - A company specialized in 3D image, cartoons and serious games
- Define of the target public
 - Students in agriculture : from high school to university
 - Training of technicians and farmers
- “Agile” software development methodology
 - collaboration between self-organizing, cross-functional teams
 - iterative and incremental development
- Involve sponsors, and future users
 - ...

20 participants and sponsors



2013 ★ ★
Innov' space

ENGELE

Environnement et Gestion de l'Élevage

ifip Institut du porc
Enseignement agricole public de Bretagne CREPA
AGRICULTURES & TERRITOIRES CHAMPAGNE D'AGRICULTURE DES PAYS DE LA LOIRE
INRA SCIENCE & IMPACT

RMT Élevages et environnement

educagri éditions
AGRICULTURES PRODUISONS AUTREMENT
INSIDE
POLYMORPH
AGRO CAMPUS

Avec le partenariat financier de :

l'Europe s'engage en Bretagne avec le FEADER
agence de l'eau Loire-Bretagne
INAPORC
Pôle de Compétences Ouest en Sciences et technologies de l'alimentation et des systèmes agricoles et agroalimentaires
AGRIAL
CAVAC
TERRENA LA NOUVELLE AGRICULTURE
Comité Régional Porcin des Pays de la Loire
FranceAgriMer

Methodology of development

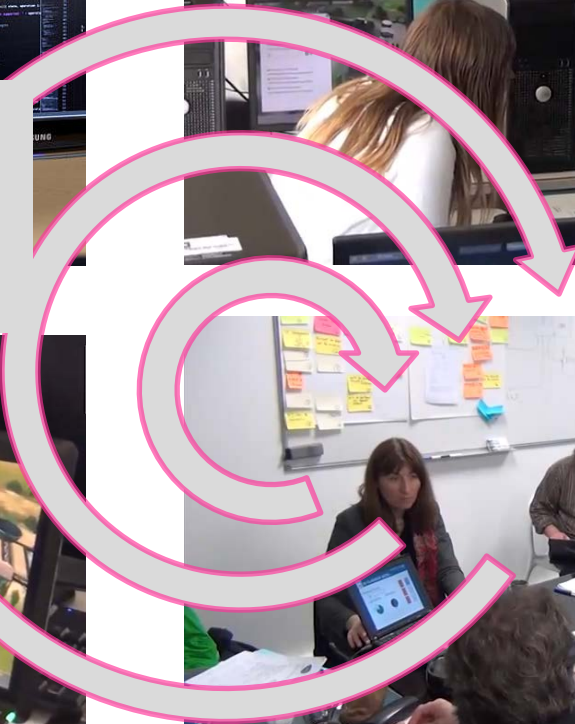
Coding

- 8 iterative « sprints »
(3 weeks each)
- A new version produced
every 2 sprints

Evaluation - Testing

Design & scenarios

Project team



A look to some input interface



- Description of animal performance
 - “Touch” the sow to check performance
- Description of housing
 - “Touch” the floor to change housing of post-weaning piglets
- Description of feeds
 - “Touch” the feeder to check feed composition for fattening pigs
- Manure management
 - “Touch” the slurry storage to add aerobic treatment of 50% of slurry

Move to the farrowing room



=> Check sows productivity



=> Change sows performance

The screenshot shows a software interface for managing sows. The background is a 3D rendering of a pig pen. Overlaid on this is a data entry form titled 'Truies'. The form contains several input fields, each with a lock icon and an information icon. The values entered are: 28 for 'Porcelets / truie / an', 7.9 for 'Poids de sevrage (kg)', 50 for 'Taux de renouvellement (%)', 240 for 'Poids à la réforme (kg)', 1250 for 'Quantité d'aliment par truie (kg / an)', and a slider for '% Alim Gestantes/Allaitantes' set at 68. A 'VALIDER' button is at the bottom right of the form. Three yellow thought bubbles with red outlines are placed over the form: one over 'Porcelets / truie / an' containing the text 'piglets/sow/year', one over 'Poids de sevrage (kg)' containing 'weaning weight', and one over 'Poids à la réforme (kg)' containing 'feed/sow/year'. A white box with the text 'SOW PRODUCTIVITY' is positioned to the right of the form. The top navigation bar includes 'Fichier', 'Retour', 'Fiches de saisie', and 'Tableau de bord'. The bottom bar shows icons for 'Azote', 'Phosphore', 'Lisier', 'Fumier', and 'Épandage'.

Truies

Porcelets / truie / an 28

Poids de sevrage (kg) 7.9

Taux de renouvellement (%) 50

Poids à la réforme (kg) 240

Quantité d'aliment par truie (kg / an) 1250

% Alim Gestantes/Allaitantes 68 32 100

VALIDER

SOW PRODUCTIVITY

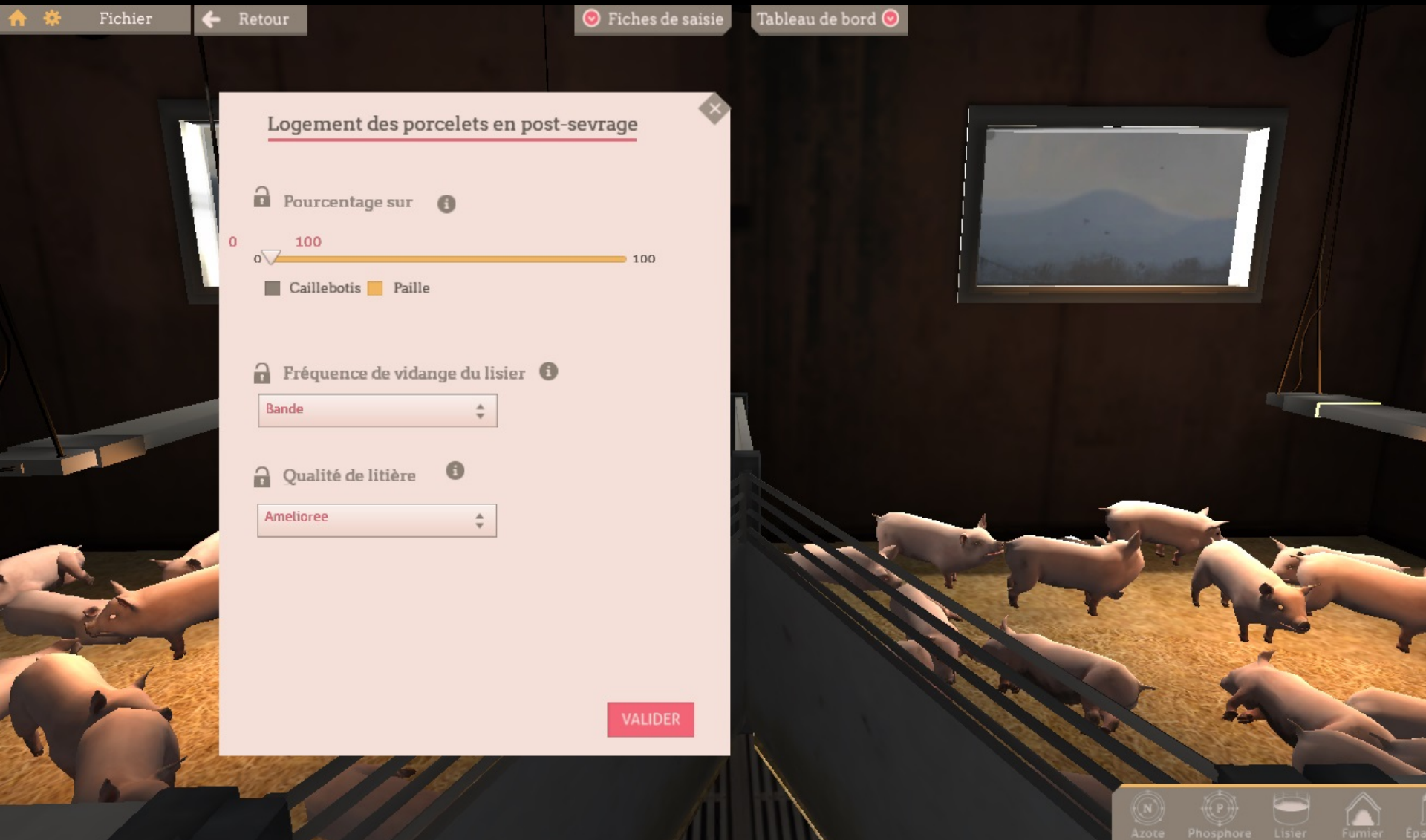
Annotations:

- 28: piglets/sow/year
- 7.9: weaning weight
- 240: feed/sow/year

=> Change housing of post-weaning piglets



=> Change housing of post-weaning piglets



=> Check feed composition of fattening pigs

The screenshot displays a simulation interface for managing a pig farm. A semi-transparent menu titled "Aliment Engraissement Croissance" is overlaid on the left, allowing the user to configure feed for three stages: "Nourrain" (represented by a pig icon and a slider set to 3), "Croissance" (represented by a pig icon and a slider set to 1), and "Finition" (represented by a pig icon and a slider set to 2). Below this, a horizontal bar chart shows the percentage of feed for each stage: 16% for Nourrain (orange), 33% for Croissance (grey), and 49% for Finition (pink). The menu also includes settings for nutrient levels, each with a lock icon and an information icon: "Teneur en protéine" (set to 16.5), "Teneur en phosphore total" (set to 4.8), and "Teneur en potassium" (set to 8). Three yellow callout bubbles highlight the "Protein", "Phosphorus", and "Potassium" settings. A "VALIDER" button is at the bottom right of the menu. The background shows a 3D rendering of a pig pen with several pigs. A white label "FEED - FATTENING PIGS" is positioned over the pen. The top navigation bar includes icons for a home, settings, and a list, along with text labels "Fichier", "Retour", "Fiches de saisie", and "Tableau de bord". The bottom status bar displays icons and labels for "Azote", "Phosphore", "Lisier", "Fumier", and "Épa".

Aliment Engraissement Croissance

Nourrain Croissance Finition

Pourcentage d'aliment par stade

16% 33% 49%

Nourrain Finition

Protein

Teneur en protéine

16.5

Phosphorus

Teneur en phosphore total

4.8

Potassium

Teneur en potassium

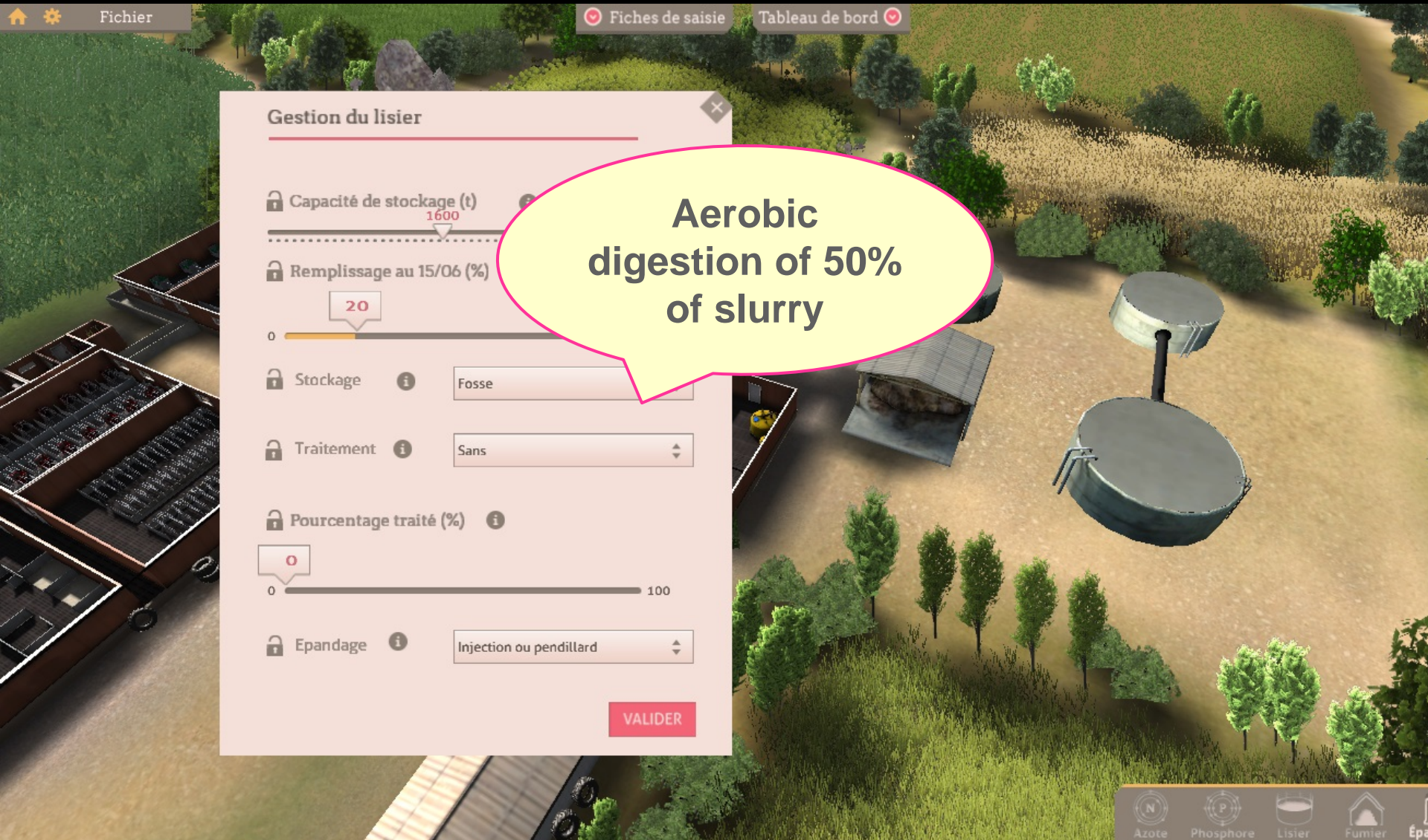
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VALIDER

FEED - FATTENING PIGS

Azote Phosphore Lisier Fumier Épa

=> Change manure management



=> Change manure management





A look to some outputs

- Real time dashboard
 - Red lights => environmental situation of the farm
- Nutrient balance
 - N and P balance
- N-gaz emissions
 - Per type of gaz
 - According to location of emission
- Environmental evaluation by Life Cycle Assessment
 - Global warming
 - Eutrophication

Real-Time dashboard



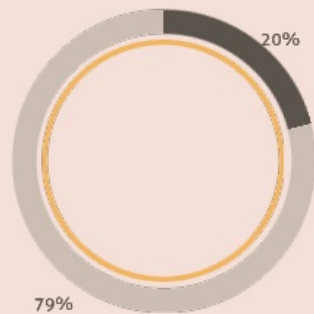
N and P balance

Fichier

Fiches de saisie

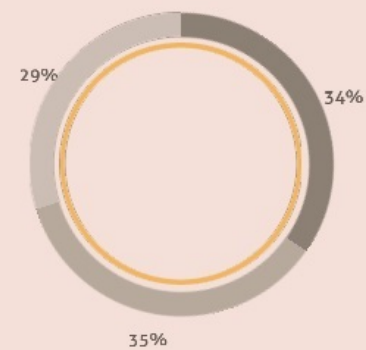
Tableau de bord

P Balance (% intake)



P retention	5642 kg
P excretion	9296 kg
P2O5 in manure	21288 kg
P2O5 spread ha :	193 kg

N Balance (% intake)

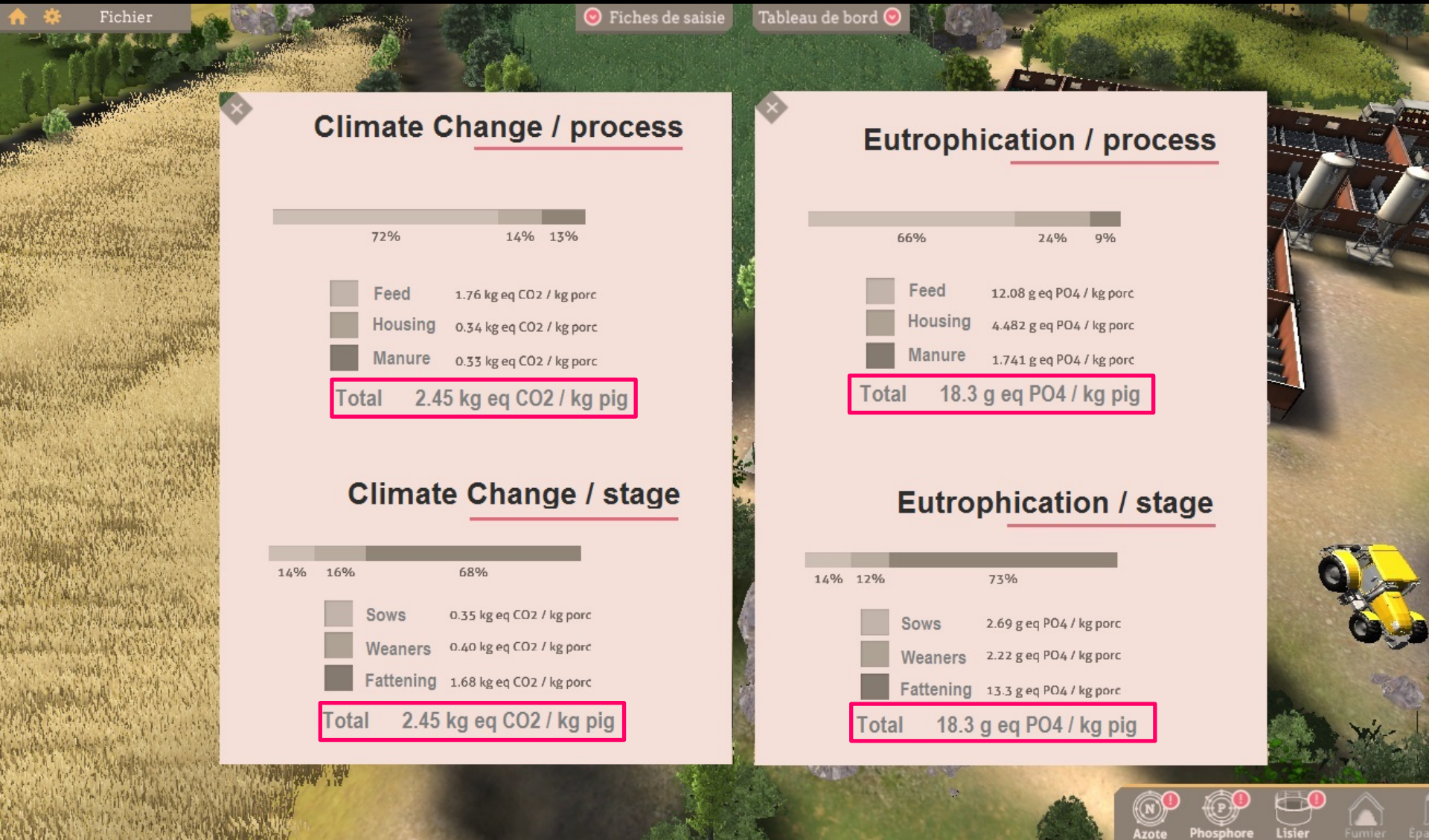


N retention	22725 kg
N in manure	27166 kg
N in gaz	26475 kg
N spread / hectare :	206 kg

N-gaz emissions



Environmental evaluation by LCA




Strategies of use

- Predefined scenarios
 - A given objective with limited possibilities
 - ⇒ A first approach adapted to self learning
- Scenarios defined by the teacher to address specific topics e.g.
 - Restore an appropriate N or P balance by improving nutrition
 - Adapt size of storage to crop rotation
 - Evaluate the effect of housing (litter *versus* slatted floor) on global warming impact of pig production
 - ⇒ The teacher define a starting point (a farm configuration) and an objective to reach
 - ⇒ He can lock some inputs to guide the solution
- “Real life” simulation
 - Evaluation of environmental impacts of a real farm
- “Free” utilization

Conclusion and perspectives

- A motivating project
 - Innovative approach for most of the participants
 - A good way to favor cooperation between research, development and education
 - Well received by the sponsors
- Serious game approach
 - Very attractive for the students / intuitive learning
 - A way to make complex models accessible for teaching
 - A good way to learn new concepts
- Perspectives
 - Diffusion of the software and large scale evaluation
 - Platform for teachers to share examples of courses
 - Extension to other animal productions (dairy, poultry)

A 3D rendered scene of a pig farm interior. Two pigs are visible in separate pens. The pens are constructed with grey concrete walls and metal bars. The floor is covered with a dark, textured material, possibly rubber mats. The background shows a dark wooden wall with a few small windows and a ceiling with fluorescent lights. Two speech bubbles are overlaid on the scene. The first speech bubble, on the left, contains the text "Thank you for your attention". The second speech bubble, on the right, contains the text "Questions are welcome".

*Thank you for
your attention*

*Questions
are welcome*