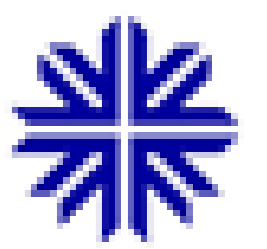




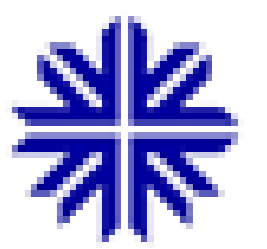
CL SURVEYS





TRANSPORTATION OF GRAIN

The Risks and Challenges





TRANSPORTATION OF GRAIN

The Risks and Challenges

- 1.SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE
- 2.GRAIN FAMILY TYPES & TRADING ORGANISATION BY TYPE
3. KEY FACTORS OF PRESERVATION AND TRANSPORTATION
- 4.RISKS
5. PRACTICAL CASE



TRANSPORTATION OF GRAIN

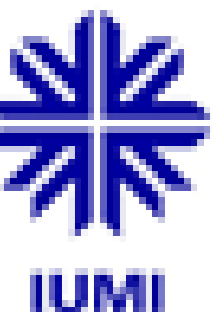
SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

Rank	Commodity	Production (Int \$1000)	Flag	Production (MT)
1	Rice, paddy	186667648	*	722559584
2	Cow milk, whole, fresh	183583111	*	614578723
3	Indigenous Cattle Meat	170272001	*	63031582
4	Indigenous Piguemeat	167007794	*	108641257
5	Indigenous Chicken Meat	128199164	*	90001779
6	Wheat	84281536	*	701395334
7	Soybeans	65903601	*	262037569
8	Tomatoes	58223483	*	159347031
9	Sugar cane	56903836	*	1800377642
10	Maize	55478433	*	885289935
11	Hen eggs, in shell	53998997	*	65181280
12	Potatoes	49681577	*	373158351
13	Vegetables fresh nes	45936531	*	268833780
14	Grapes	39494901	*	69093293
15	Buffalo milk, whole, fresh	37673032	*	95811113
16	Cotton lint	37363750	*	26143049
17	Apples	31706244	*	75484671
18	Bananas	29721954	*	107142187
19	Cassava	24924197	*	256404044
20	Mangoes, mangosteens, guavas	23338979	*	38953166

Source FAO 2012

Among the 20 highest produced commodities in the world,

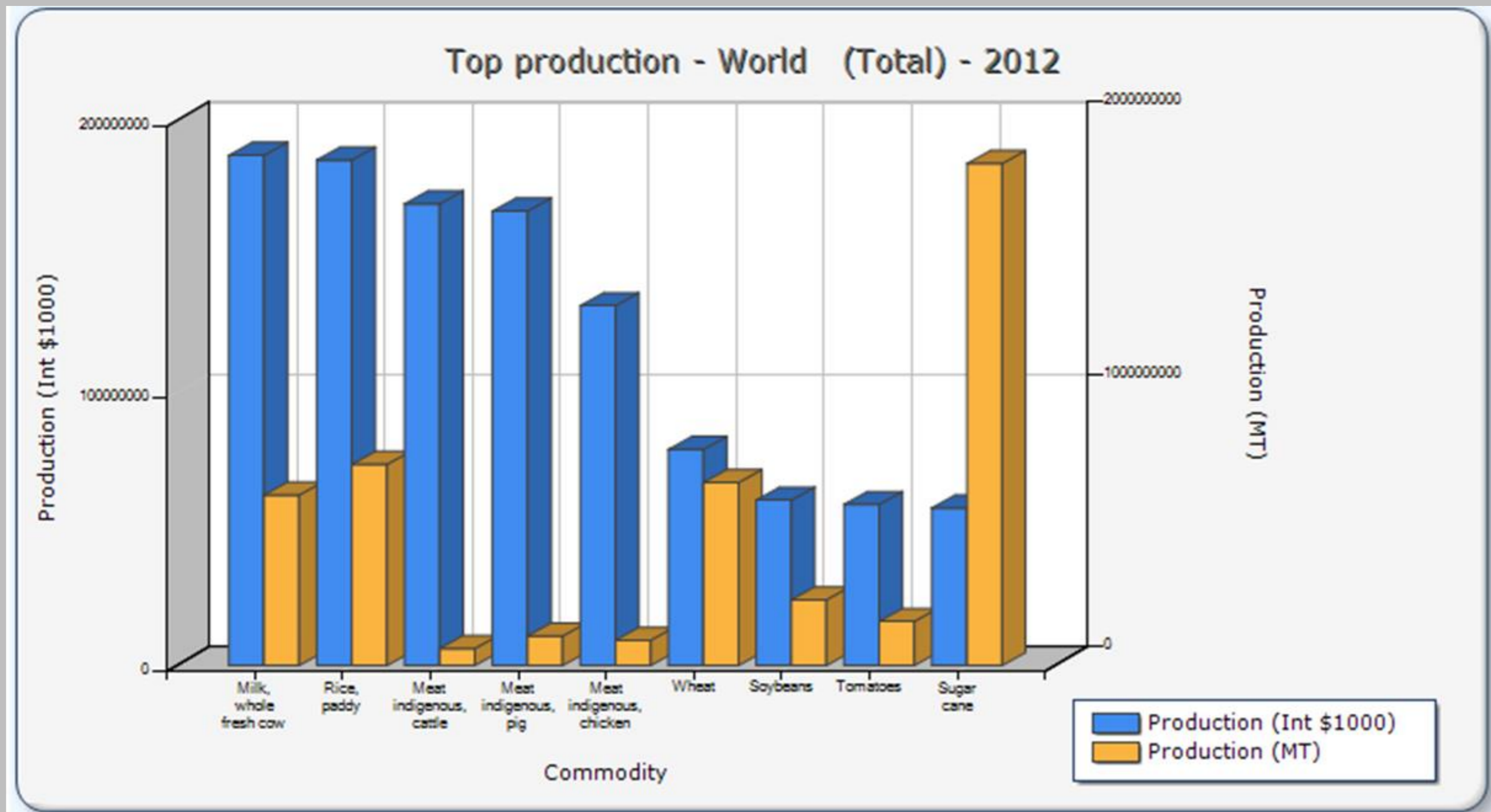
- 4 are grain related (rice, wheat, soybeans and maize)
- representing 2,5 billions tons / year





TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

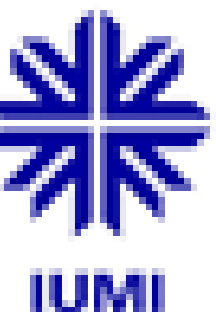


Ratio valuation

Tonnage versus value, grain production represents a major issue :

Rice and wheat alone (which are the base commodities in the human food chain) represent a production value of abt

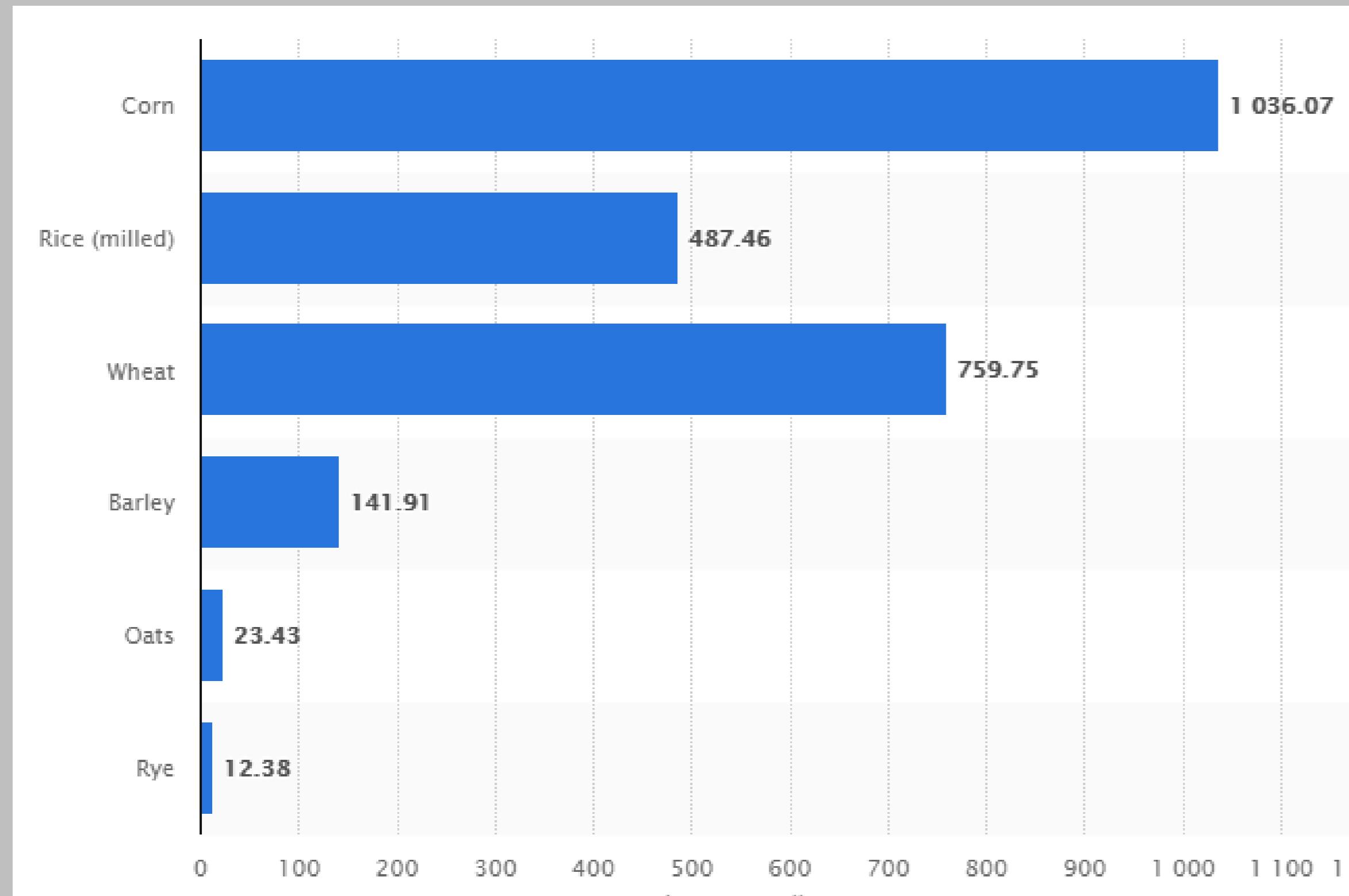
250 billions USD





TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

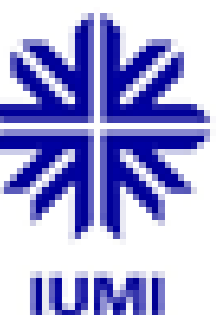


from 2012/2013 to 2017/2018

Maize production increased about 17%

whereas wheat remained relatively stable (+8%)

(2017/2018 production figures in Mt)





TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

But when it comes to international trade (2012-2013) :

→ Wheat is the n°1 perishable cargo transported in the world (bananas only rank 10)

→ 12 of these commodities (out of the 20 most int. traded) are related to grain

TOP 20 SOFT COMMODITIES : EXPORT originating or processed from agricultural crops

RANK	
1	Wheat
2	Maize
3	Soybeans
4	Cake soybeans
5	Oil, palm
6	Rice—total (rice milled equivalent)
7	Sugar raw (centrifugal)
8	Barley
9	Sugar refined
10	Bananas
11	Rapeseed
12	Flour, wheat
13	Barley (for malt)
14	Potatoes
15	Wine
16	Oil soybean
17	Cake rapeseed
18	Apples
19	Cotton lint
20	Rubber natural dry

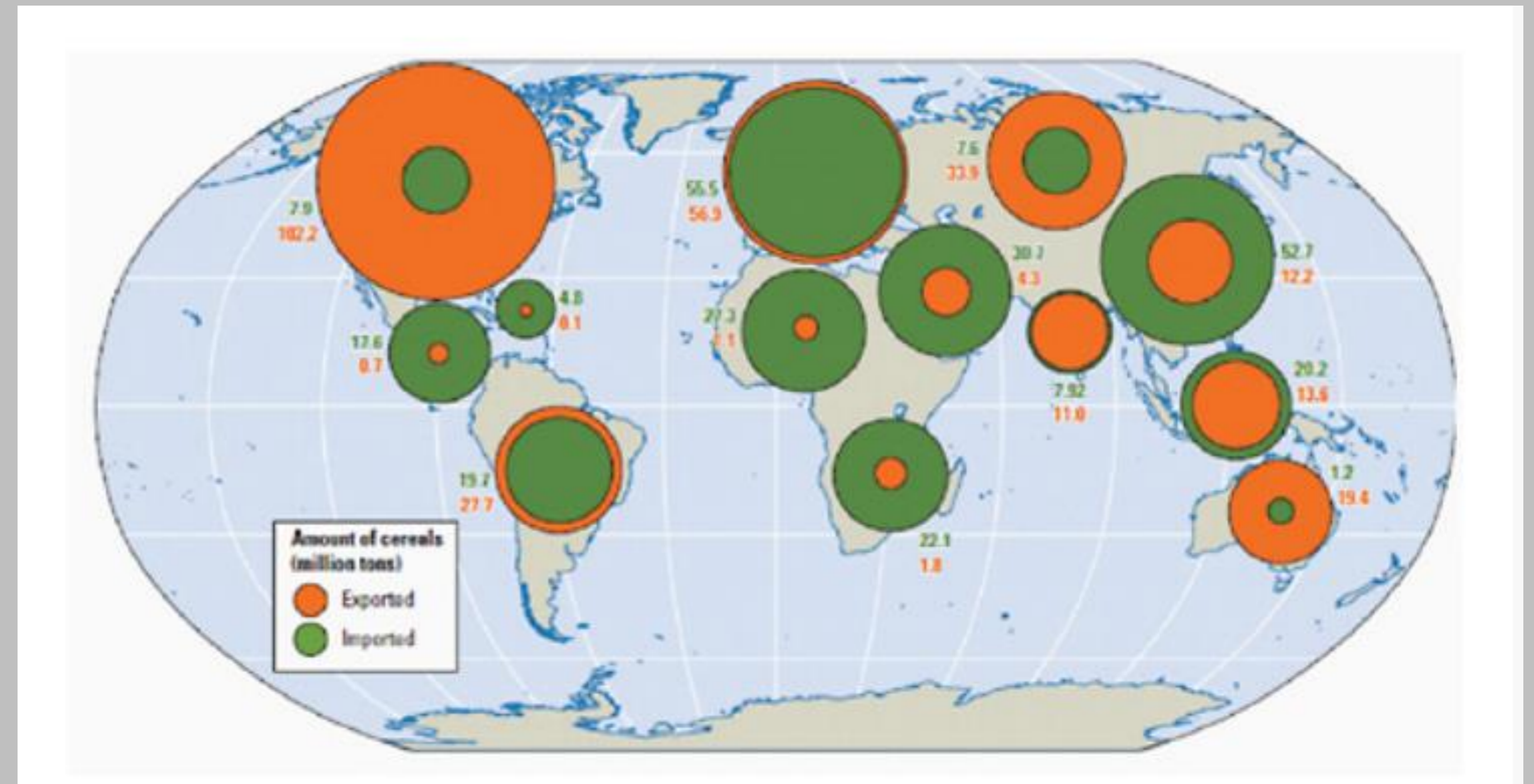




TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

This map (FAO) shows how cereal production and trade depends on a few countries (notably exports)



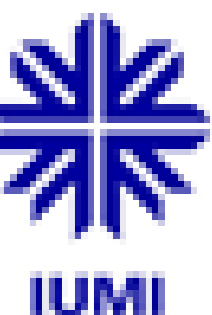


TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE



In million Mt

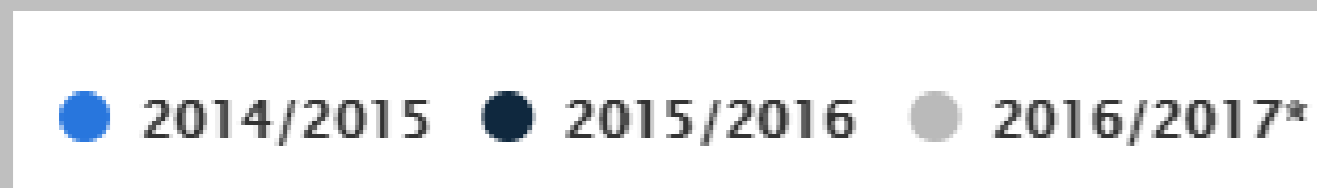




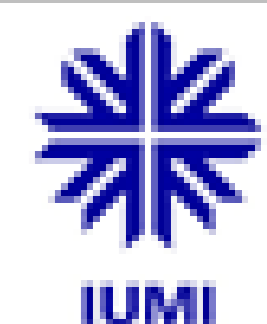
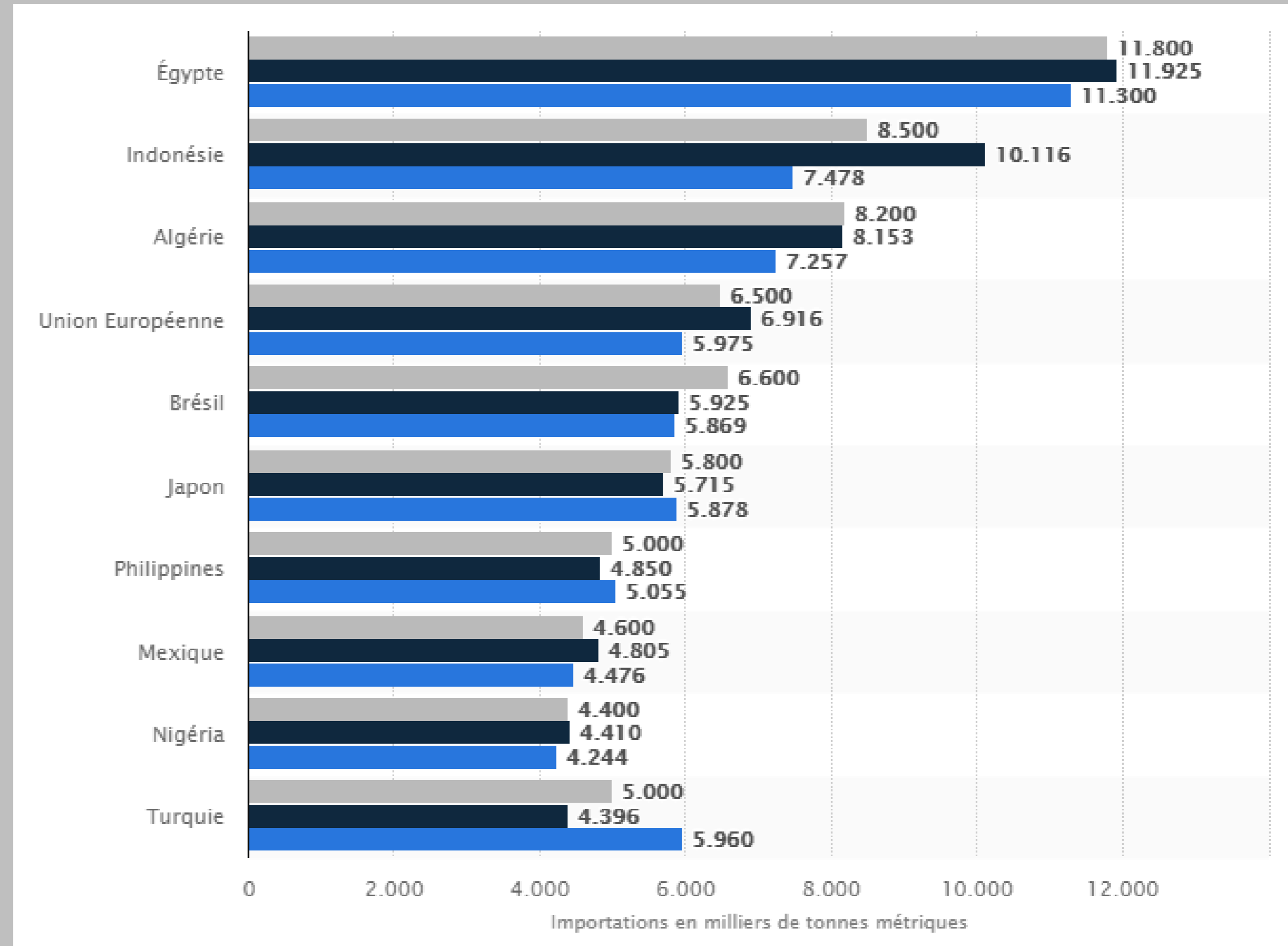
TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

Specifically regarding wheat
(in 1 000 Mt)



(til November for 2017)





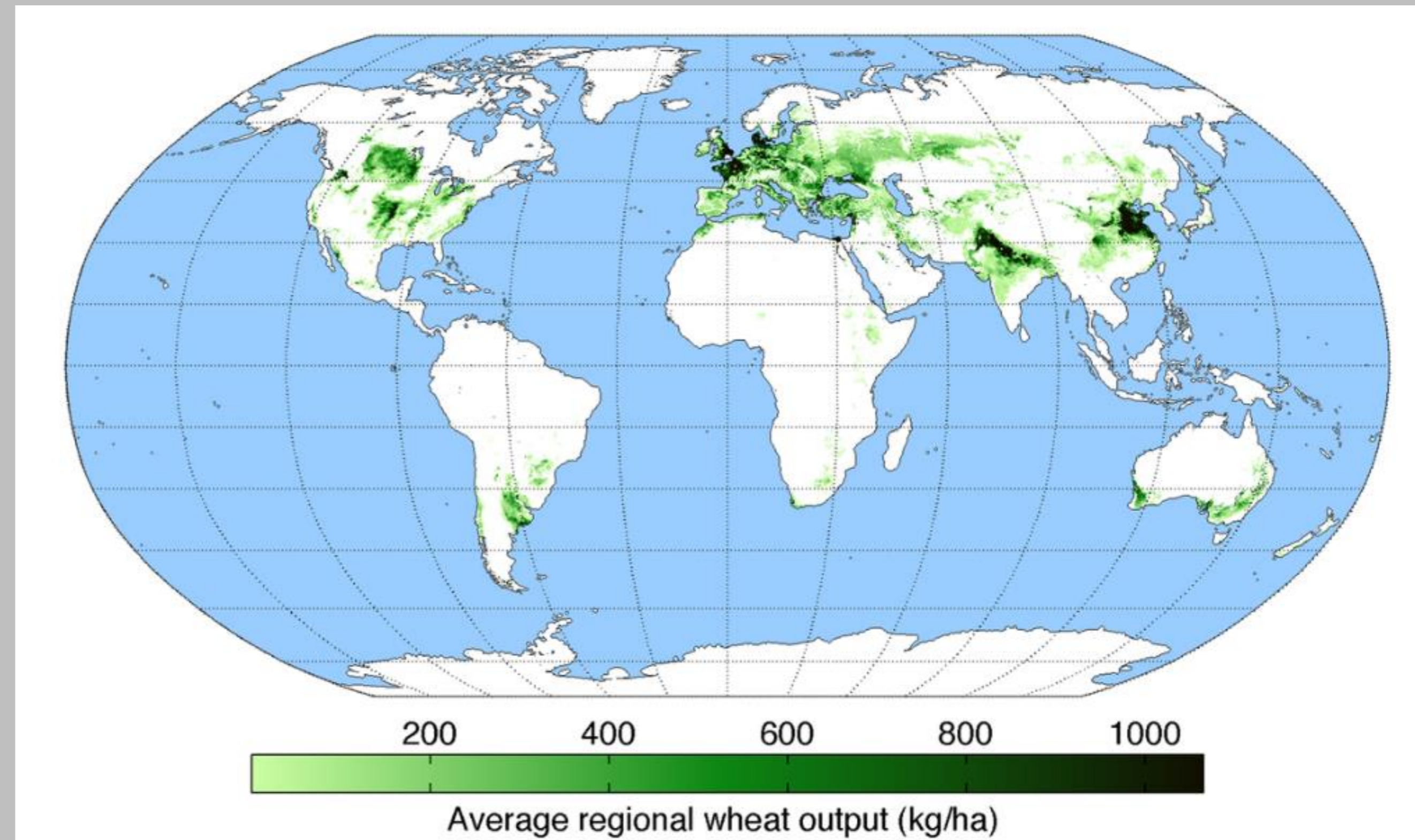
TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

This is even more representative :

This map shows the wheat productivity per hectare in the world

Only 7 regions of the world are highly productive (dark green) and are in a position to generate exports



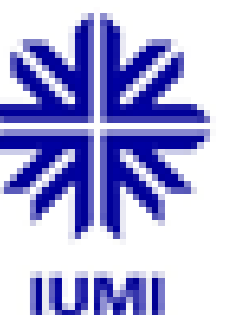
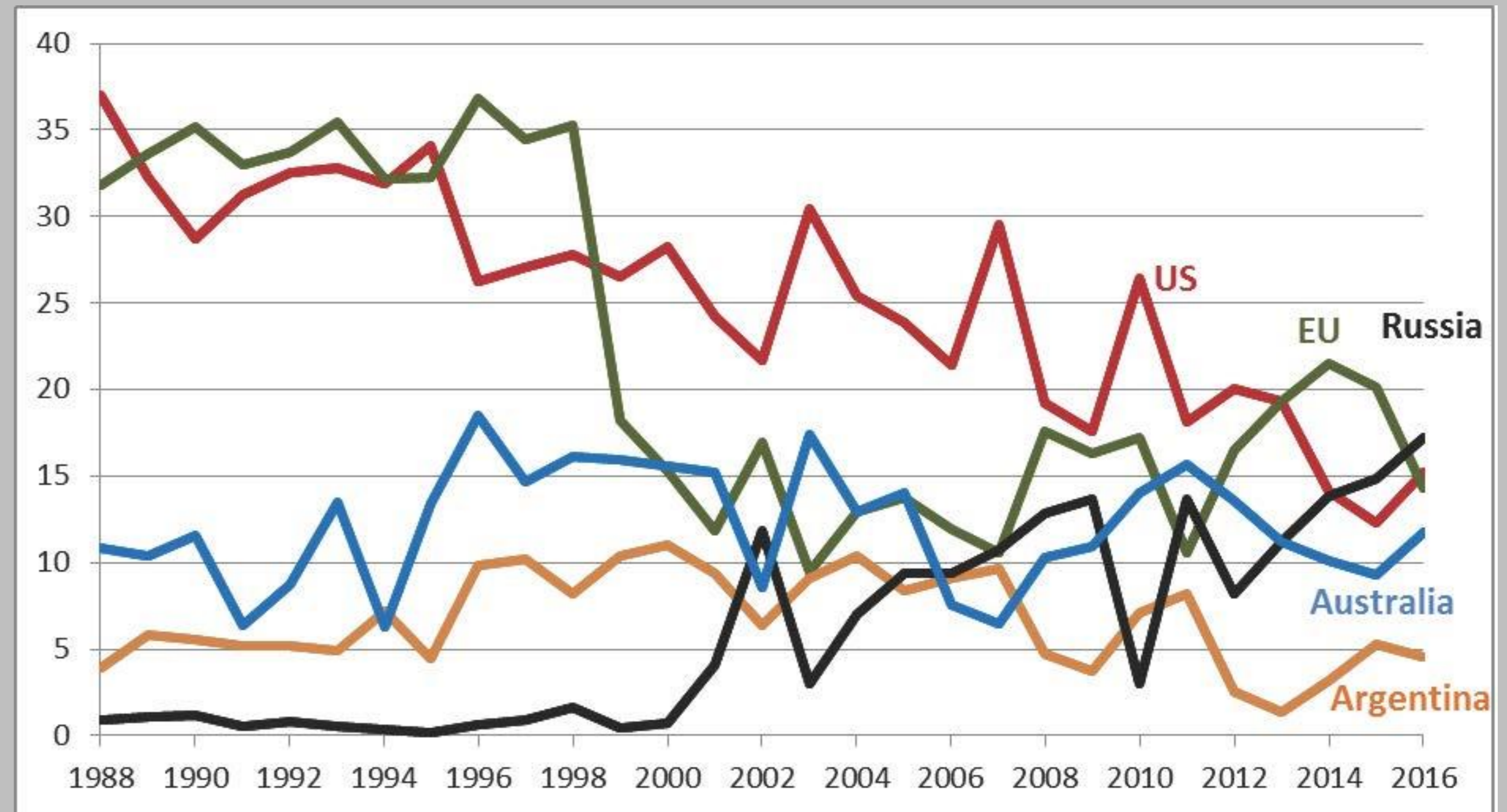


TRANSPORTATION OF GRAIN

SOME KEY FIGURES ABOUT INTERNATIONAL GRAIN PRODUCTION AND TRADE

Grain export is in the hands of a few countries / areas

- Wheat market trends have evolved quite significantly over the last 20 years
- Whereas maize and oil seed export areas remain quite stable (North and South America) represent abt. 2/3 of the world exports





TRANSPORTATION OF GRAIN

GRAIN TYPES

In « botanical terms », traded grain can be classified into two types :

- Cereals : rice, wheat, maize, etc... (grass type)
- Legumes : peas, soya, etc... (grain in pod)



In terms of risk of preservation / transportation, the classification should rather be as follows :

- Cereals : rice, wheat, barley, maize etc...
- Oil seeds : soya, rape seed, sun flower seed etc

which is a better representative of the scale of risk



TRANSPORTATION OF GRAIN

MARKET ORGANISATION

Trade of grains (raw product and processed product) is strictly regulated by strong inter-professional organisations :

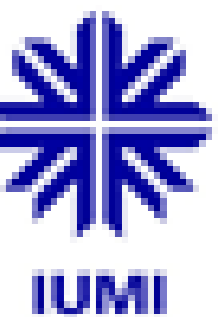
- GAFTA for cereals (grains else than FOSFA related) plus fishmeal and fertilizers
- FOSFA for oil seed, oil and seed cake

These associations are drafting a number of contract models depending on the terms of the commodity, origin, type of sale, etc...

- **Cereals & Grain** (wheat, rice, maize, etc...) : GAFTA
- **Oil, oilseeds & meals** (soya, sunflower, etc...) FOSFA
- **Cocoa** FCC & CMA
- **Coffee** Regionals organisation (ECF,...)
- **Sugar** Sugar Association of London – Sugar Association (USA)
- **Coton** ICA
- **Meat** International Meat Trade Association

The agreed terms of inspection and accredited superintend are also regulated

Claim arbitration is held within strict rules by these associations





TRANSPORTATION OF GRAIN

MARKET ORGANISATION

Effective 1st March 2016

Contract No.54A



Copyright
THE GRAIN AND FEED TRADE ASSOCIATION

CONTRACT FOR BALTIC GRAIN IN BULK OR BAGS PARCELS OR CARGOES RYE TERMS - CIF/CIFFO/C&F/C&FFO TERMS

** delete/specify as applicable*

Date

1 **SELLERS**.....

2
3 **INTERVENING AS BROKERS**.....

4
5 **BUYERS**.....

6 have this day entered into a contract on the following terms and conditions.

7
8 **1. GOODS**.....
9 in bulk and/or in bags. If in bags, then the bags to be of suitable strength to withstand ordinary wear and tear to
10 port of destination. Such bags to be taken and paid for as goods.

11
12 **2. QUANTITY** 2% more or less
13 Sellers have the option of shipping a further 3% more or less on a parcel, or a further 8% more or less on a
14 cargo, on contract quantity, excess or deficiency over the above 2% to be settled at the market price on the date
15 of the last bill of lading, and on the quantity thereof; value to be fixed by arbitration, unless mutually agreed. In
16 the event of more than one shipment being made each shipment to be considered a separate contract, but the
17 margin on the mean quantity sold not to be affected thereby.

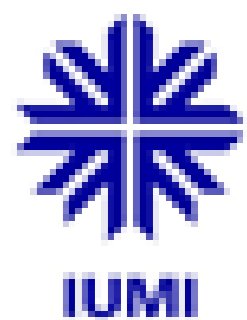
18
19 **3. PRICE AND DESTINATION**
20 At the price per tonne of 1,000 kilograms gross weight of

21
22 *cost, insurance and freight to.....

23
24 *cost, insurance and freight free out to

25
26 *cost and freight to

27

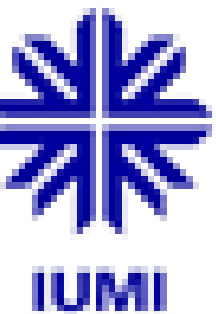




TRANSPORTATION OF GRAIN

MARKET ORGANISATION

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59	6. PERIOD OF SHIPMENT
60	As per bill(s) of lading dated or to be dated
61	The bill(s) of lading to be dated when the goods are actually on board. Date of the bill(s) of lading shall be
62	accepted as proof of date of shipment in the absence of evidence to the contrary. In any month containing an
63	odd number of days, the middle day shall be accepted as being in both halves of the month.
64	
65	7. SALES BY NAMED VESSELS
66	For all sales by named vessels, the following shall apply:-
67	(a) Position of vessel is mutually agreed between Buyers and Sellers;
68	(b) The word "now" to be inserted before the word "classed" in the Ship's Classification Clause;
69	(c) Appropriation Clause cancelled if sold "shipped".
70	
71	8. SHIP'S CLASSIFICATION
72	Shipment from
73	by first class mechanically self-propelled vessel(s) suitable for the carriage of the contract goods, classed in
74	accordance with the Institute Classification Clause of the International Underwriting Association in force at
75	time of shipment, excluding tankers and vessels which are either classified in Lloyd's Register or described in
76	Lloyd's Shipping Index as "Ore/Oil" vessels.
77	
78	9. NOMINATION OF VESSEL(S) FOR CONTRACTS CONCLUDED ON C & F TERMS
79	(a) At a date agreed between the Parties but in any event prior to the commencement of loading, Sellers
80	shall nominate the intended carrying vessel(s) to Buyers. The vessel(s) nominated shall comply with the
81	terms of the Institute Classification Clause and any other requirements as set out in the contract.
82	(b) Sellers are entitled to substitute the nomination(s) provided that the substituting vessel(s) complies
83	with the terms of this clause.
84	
85	10. EXTENSION OF SHIPMENT
86	The contract period for shipment, if such be 31 days or less, shall be extended by an additional period of not
87	more than 8 days, provided that Sellers serve notice claiming extension not later than the next business day
88	following the last day of the originally stipulated period. The notice need not state the number of additional
89	days claimed.
90	Sellers shall make an allowance to Buyers, to be deducted in the invoice from the contract price, based on the
91	number of days by which the originally stipulated period is exceeded, in accordance with the following scale: -
92	1 to 4 additional days, 0.50%;
93	5 or 6 additional days, 1%;
94	7 or 8 additional days 1.50% of the gross contract price.
95	If, however, after having served notice to Buyers as above, Sellers fail to make shipment within such 8 days,
96	then the contract shall be deemed to have called for shipment during the originally stipulated period plus 8





TRANSPORTATION OF GRAIN

MARKET ORGANISATION

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13. INSURANCE

13.1 For Contracts Concluded on CIF Terms Sellers shall provide insurance on terms not less favourable than those set out hereunder, and as set out in detail in GAFTA Insurance Terms No.72 viz.: -

(a) Risks Covered: -

Cargo Clauses (WA) with average payable, with 3% franchise or better terms - Section 2 of Form 72

War Clauses (Cargo) - Section 4 of Form 72

Strikes, Riots and Civil Commotions Clauses (Cargo) - Section 5 of Form 72

(b) Insurers - The insurance to be effected with first class underwriters and/or companies who are domiciled or carrying on business in the United Kingdom or who, for the purpose of any legal proceedings, accept a British domicile and provide an address for service of process in London, but for whose solvency Sellers shall not be responsible.

(c) Insurable Value - Insured amount to be for not less than 2% over the invoice amount, including freight when freight is payable on shipment or due in any event, ship and/or cargo lost or not lost, and including the amount of any War Risk premium payable by Buyers.

(d) Freight Contingency - When freight is payable on arrival or on right and true delivery of the goods and the insurance does not include the freight, Sellers shall effect insurance upon similar terms, such insurance to attach only as such freight becomes payable, for the amount of the freight plus 2%, until the termination of the risk as provided in the above mentioned clauses, and shall undertake that their policies are so worded that in the case of a particular or general average claim the Buyers shall be put in the same position as if the C.I.F. value plus 2% were insured from the time of shipment.

(e) Certificates/Policies - Sellers shall give all policies and/or certificates and/or letters of insurance provided for in this contract, (duly stamped if applicable) for original and increased value (if any) for the value stipulated in (c) above. In the event of a certificate of insurance being supplied, it is agreed that such certificate shall be exchanged by Sellers for a policy if and when required and such certificate shall state on its face that it is so exchangeable. If required by Buyers, letter(s) of insurance shall be guaranteed by a recognised bank, or by any other guarantor who is acceptable to Buyers.

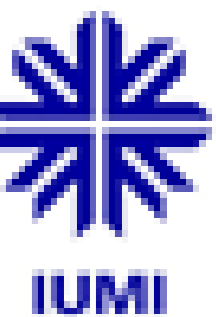
(f) Total Loss - In the event of total or constructive total loss, or where the amount of the insurance becomes payable in full, the insured amount in excess of 2% over the invoice amount shall be for Sellers' account and the party in possession of the policy (ies) shall collect the amount of insurance and shall thereupon settle with the other party on that basis.

(g) Currency of Claims - Claims to be paid in the currency of the contract.

(h) War and Strike Risks Premiums - Any premium in excess of 0.50% to be for account of Buyers. The rate of such insurance not to exceed the rate ruling in London at time of shipment or date of vessel's sailing whichever may be adopted by underwriters. Such excess premium shall be claimed from Buyers, wherever possible, with the Provisional Invoice, but in no case later than the date of vessel's arrival, or not later than 7 consecutive days after the rate has been agreed with underwriters, whichever may be the later, otherwise such claim shall be void unless, in the opinion of Arbitrators, the delay is justifiable. Sellers' obligation to provide War Risk Insurance shall be limited to the terms and conditions in force and generally obtainable in London at time of shipment.

(i) Where Sellers are responsible for allowances or other payments to Buyers under Rye Terms or other contractual terms, (and which risks are also covered by the insurance provided by Sellers), the Buyers, on receipt of settlement, shall immediately return to Sellers the insurance documents originally received from them and shall, if required, subrogate to Sellers all right of claim against the Insurers in respect of such matters.

13.2 For Contracts Concluded on C & F Terms - Buyers shall be responsible for obtaining insurance cover as per Clause 13.1 above and shall, if required by Sellers, provide evidence to Sellers prior to the commencement of loading that they have obtained suitable cover. If Buyers refuse or fail to provide evidence Sellers are entitled (but not obliged) to cover insurance on the same terms at the Buyers' expense.





TRANSPORTATION OF GRAIN

MARKET ORGANISATION

243 grab(s) shall be permitted unless specifically excluded at time of contract. If shipment is effected by lash
244 barge, then the last day of discharge shall be the day of discharging the last lash barge at the port of
245 destination

246

247 **16. WEIGHING**

248 The terms and conditions of GAFTA Weighing Rules No.123 are deemed to be incorporated into this contract.
249 Unless otherwise agreed, final settlement shall be made on the basis of gross delivered weights at time and
250 place of discharge at Buyers' expense. If the place of destination is outside the port limits, Buyers agree to pay
251 the extra expenses incurred by Sellers or their agents for weighing. If final at time and place of loading, as per
252 GAFTA registered superintendents' certificate at Sellers' choice and expense, (in which case the Deficiency
253 Clause will not apply).

254

255 **17. DEFICIENCY**

256 Any deficiency in the bill of lading weight shall be paid for by Sellers and any excess over bill of lading
257 weight shall be paid for by Buyers at contract price, (unless the Pro-rata clause applies).

258

259 **18. RYE TERMS**

260 Condition guaranteed on arrival, (subject to any country damaged grain in the fair average quality of the
261 season's crop), slight dry warmth not injuring the grain not to be objected to. In the event of goods arriving
262 at destination damaged or out of condition, Buyers shall be entitled to an allowance for deterioration
263 calculated on a percentage based on the contract price to be fixed by arbitration unless mutually agreed.

264 In the event of Buyers receiving an allowance from Sellers under this clause, Sellers and Buyers shall give all
265 reasonable assistance to each other in the prosecution of the claim for recovery from shipowners and/or
266 other parties. Any sum recovered under this clause shall be for the benefit of Sellers, and any proven
267 reasonable expenses incurred by Buyers in connection with the claim shall be deducted.

268 Buyers shall furnish Sellers on settlement of Rye Terms allowances with the usual documents required by
269 average adjusters for preparation of average statement and return to Sellers the policy (ies) and/or
270 certificates received from them and in addition documents for claiming against the ship or any party, failing
271 which Buyers shall pay contribution to average as Sellers may be unable to recover in consequence.

272

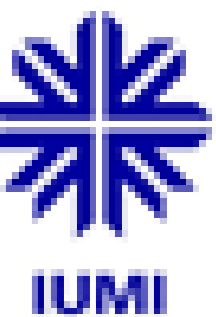
273 **19. SAMPLING, ANALYSIS AND CERTIFICATES OF ANALYSIS**

274 The terms and conditions of GAFTA Sampling Rules No. 124 are deemed to be incorporated into this
275 contract. Samples shall be taken at the time of discharge on or before removal from the ship or quay, unless
276 the parties agree that quality final at loading applies, in which event samples shall be taken at time and
277 place of loading. The parties shall appoint superintendents, for the purposes of supervision and sampling of
278 the goods, from the GAFTA Register of Superintendents. Unless otherwise agreed, analysts shall be
279 appointed from the GAFTA Register of Analysts.

280

281 **20. PREVENTION OF SHIPMENT**

282 "Event of Force Majeure" means (a) prohibition of export or other executive or legislative act done by or on
283 behalf of the government of the country of origin or of the territory where the port or ports named herein
284 is/are situate, restricting export, whether partially or otherwise, or (b) blockade, or (c) acts of terrorism, or
285 (d) hostilities, or (e) strike, lockout or combination of workmen, or (f) riot or civil commotion, or (g)





TRANSPORTATION OF GRAIN

MARKET ORGANISATION

458 of law or equity to the contrary notwithstanding.

459

460 **28. ARBITRATION**

461 (a) Any and all disputes arising out of or under this contract or any claim regarding the interpretation or
462 execution of this contract shall be determined by arbitration in accordance with the GAFTA Arbitration
463 Rules, No 125, in the edition current at the date of this contract; such Rules are incorporated into and form
464 part of this Contract and both parties hereto shall be deemed to be fully cognisant of and to have expressly
465 agreed to the application of such Rules.

466 (b) Neither party hereto, nor any persons claiming under either of them shall bring any action or other legal
467 proceedings against the other in respect of any such dispute, or claim until such dispute or claim shall first
468 have been heard and determined by the arbitrator(s) or a board of appeal, as the case may be, in accordance
469 with the Arbitration Rules and it is expressly agreed and declared that the obtaining of an award from the
470 arbitrator(s) or board of appeal, as the case may be, shall be a condition precedent to the right of either
471 party hereto or of any persons claiming under either of them to bring any action or other legal proceedings
472 against the other of them in respect of any such dispute or claim.

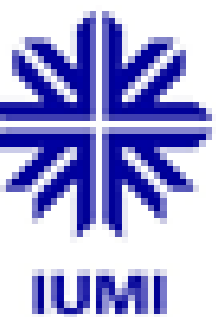
473 (c) Nothing contained under this Arbitration Clause shall prevent the parties from seeking to obtain security

54A/8

474 in respect of their claim or counterclaim via legal proceedings in any jurisdiction, provided such legal
475 proceedings shall be limited to applying for and/or obtaining security for a claim or counterclaim, it being
476 understood and agreed that the substantive merits of any dispute or claim shall be determined solely by
477 arbitration in accordance with the GAFTA Arbitration Rules, No 125.

478

479 **29. INTERNATIONAL CONVENTIONS**





TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

Reserve carbohydrate ($C_6 H_{12} O_6$) + Oxygen (O_2)



Carbon dioxide (CO_2) + Water (H_2O) + Energy (heat) (plus in some cases Ethylene (C_2H_2))

Potential life storage is impacted by the speed of consumption for carbohydrate : the slower it is, the longer the preservation of the commodity

How to reduce the speed of this reaction :

- Reduce water availability (moisture content) : moisture control
- Reduce temperature : temperature control
- Reduce oxygen availability : controlled or modified atmosphere



TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

What happens if you do not control these factors



- Phase 1 : Degradation of nutrititional value (protein degradation, lipids degradation, increase in acidity,...)
- Phase 2 : Water migration, micro-organism growth (mold) and temperature increase self feed the cycle
collateral effects : flair (non typical odour) and pest development
- Phase 3 : Heating process and water vapour production
- Phase 4 : Germination for raw grain (not for milled rice and cocoa beans as germination was inhibited by fermentation)
- Phase 5 « option » : self-heating which may leads to self-combustion



TRANSPORTATION OF GRAIN

KEY FACTORS FOR PRESERVATION AND TRANSPORTATION





TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

THE KEY FACTOR FOR GRAIN PRESERVATION



MOISTURE (%)

THE SECONDARY FACTORS



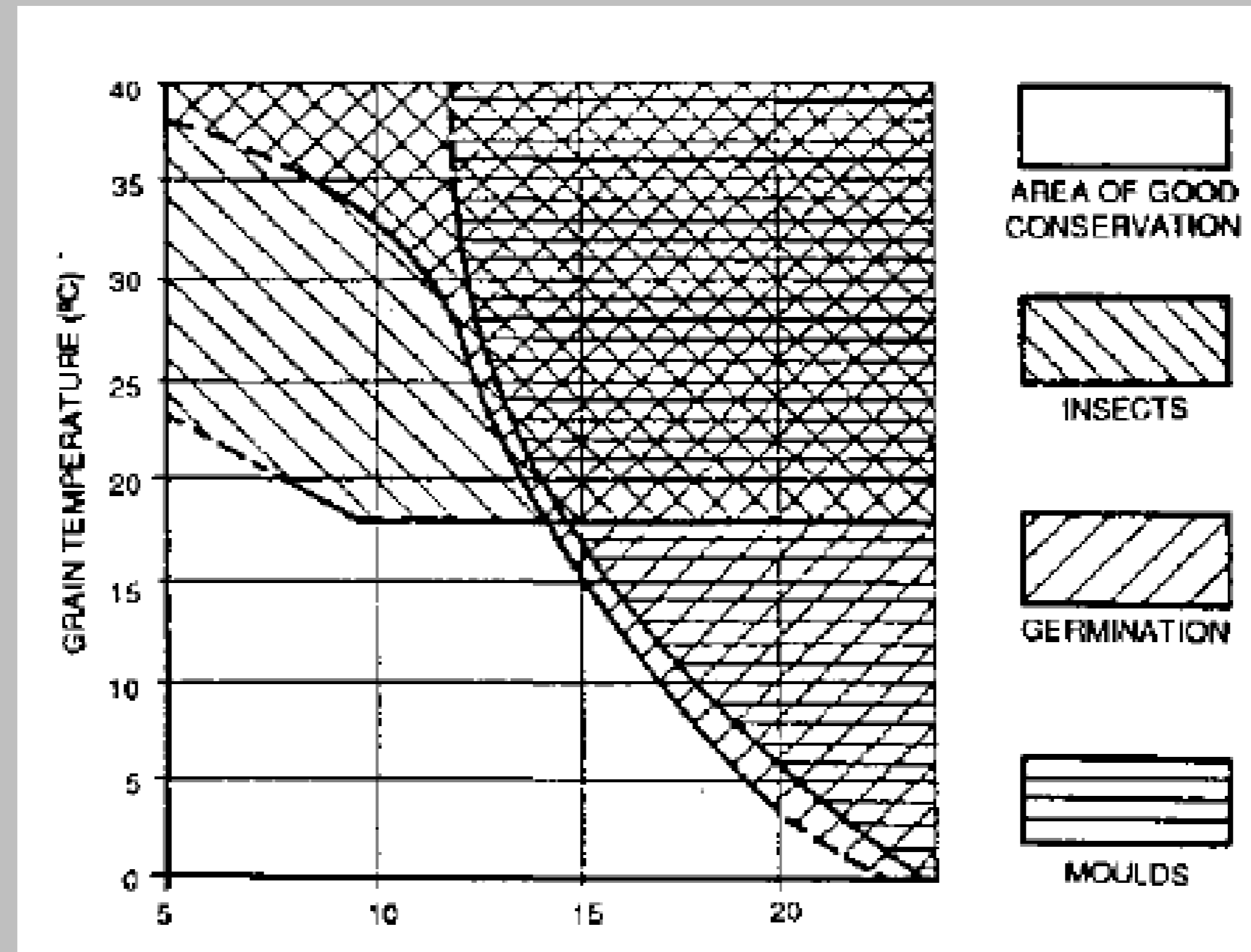
SANITARY CONDITION, TEMPERATURE CONDITION, PEST CONDITION



TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

« PRESERVATION AREAS »





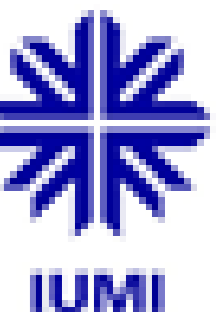
TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

E.M.C. : MOISTURE (%)
As per FAO CODEX ALIMENTARIUS

Commodity	E.M.C. (max moisture for preservation)
Wheat	14,5%
Wheat flour	15,5%
Rice	15,0%
Corn	15,0%
Barley (common)	14,5%
Barley (beer)	14,0%
Sorghum	14,5%
Millet	14,5%

<http://www.fao.org/3/a-a1392e.pdf>



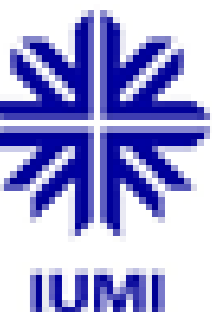


TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

E.M.C. : MOISTURE (%)

Commodity	E.M.C. (max. moisture for preservation)
Cocoa beans	7,5% to 8,0%
Green coffee beans	12,5 to 13%
Soyabeans	14%
Soyameal	12,5%
Rapeseed	9%
Sunflower seed	9%
Peanuts	9%
Fishmeal	10%





TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

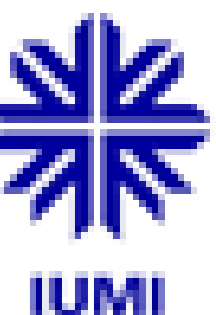
These values are usual contractual sale specifications which are controlled and certified by superintendancy / inspection (GAFTA – FOSFA accredited).

Does this mean that a quality certificate, issued at loading by a first class international company, is a guarantee that the commodity is fit to be transported without risk of damage/moisture issues ?

POOLING QUESTION

YES

NO





TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

Answer is

NO

Such a certificate is not a guarantee, for a number of reasons :

- The concept of moisture is dynamic and not static

But also

- The way the inspections are being carried out as per GATFA rule 124

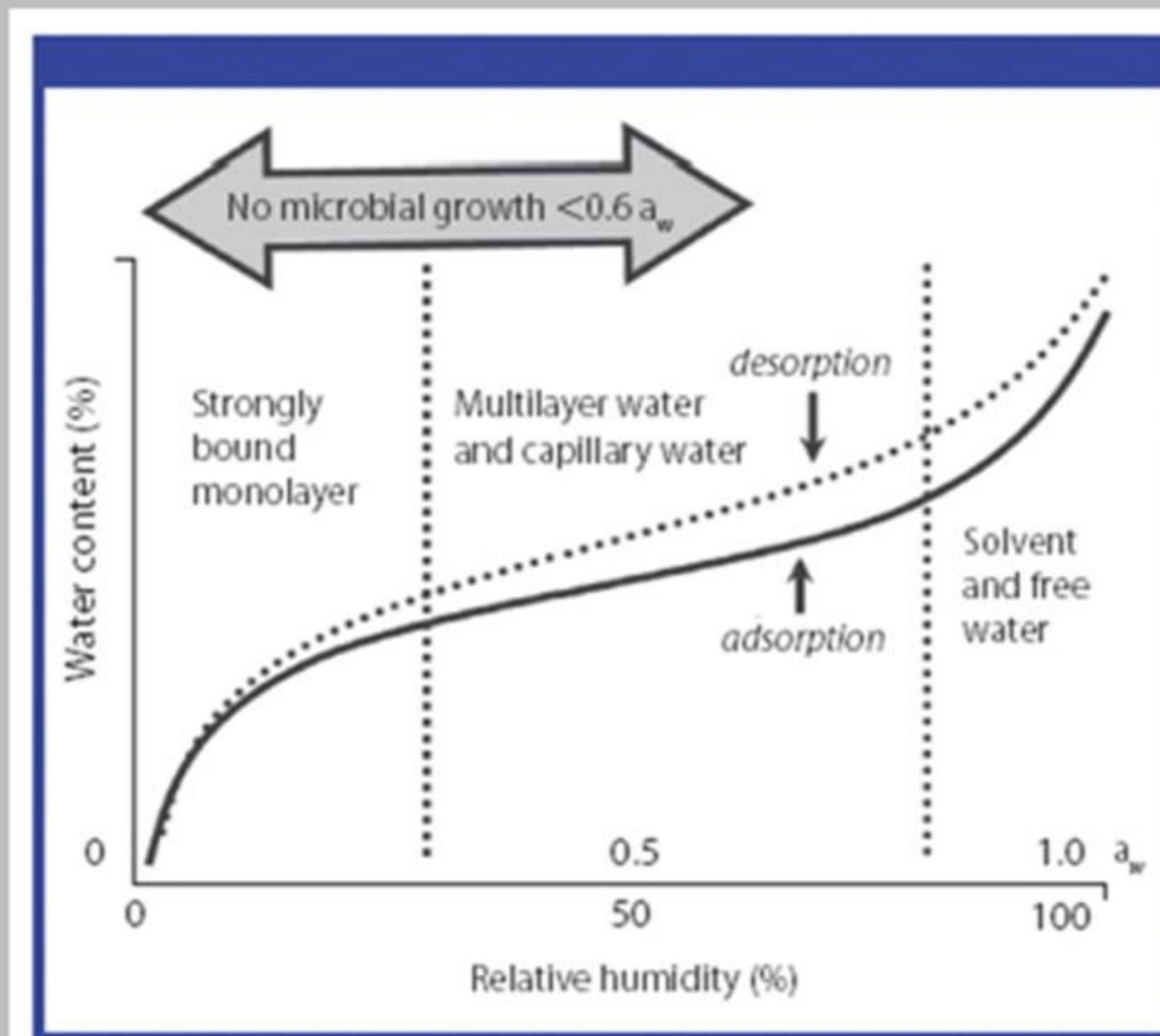


TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

MOISTURE (%)

ISOTHERM OF SORPTION DESORPTION
EMC : EQUILIBRIUM WATER CONTENT

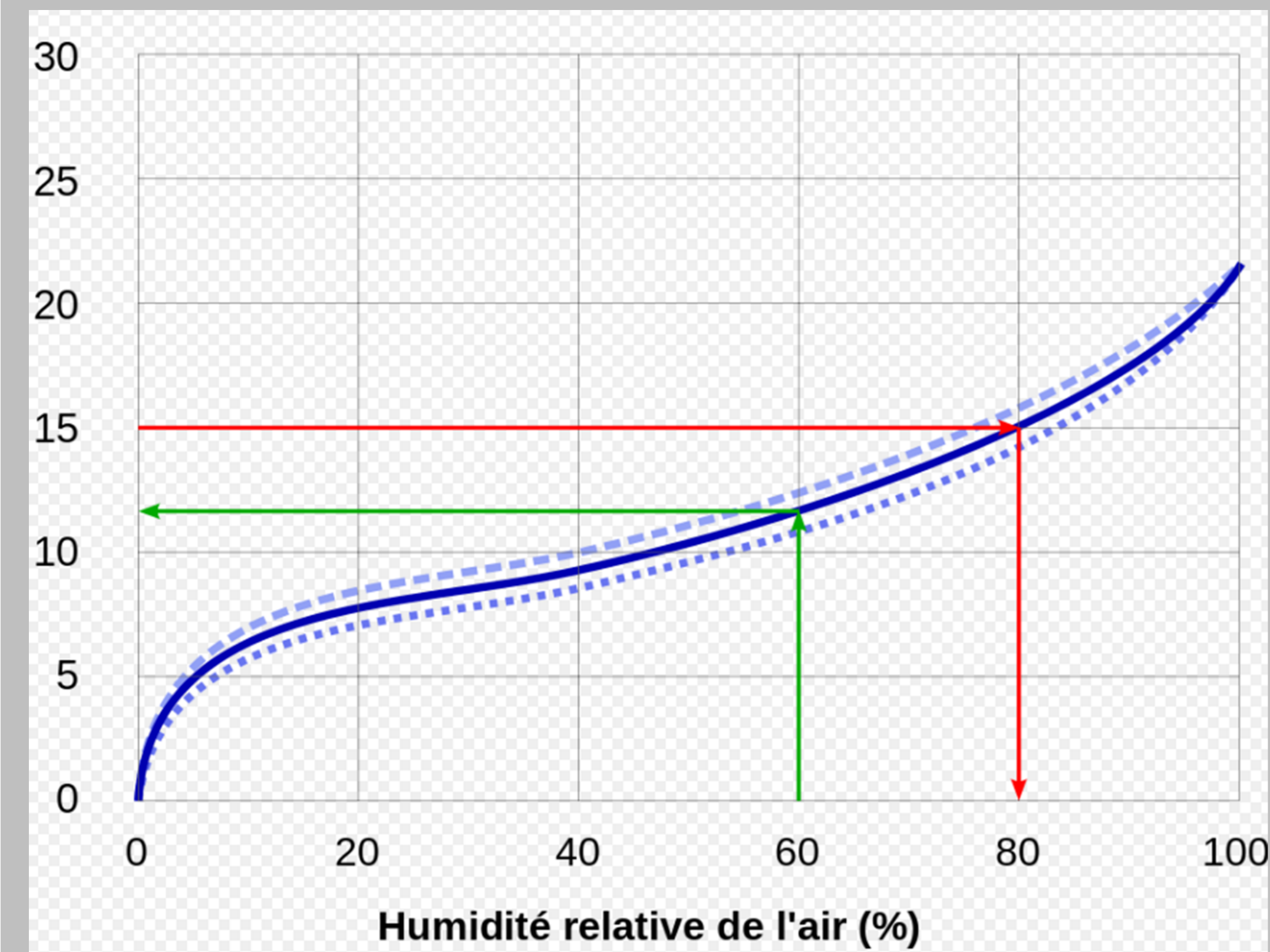




TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

MOISTURE (%)

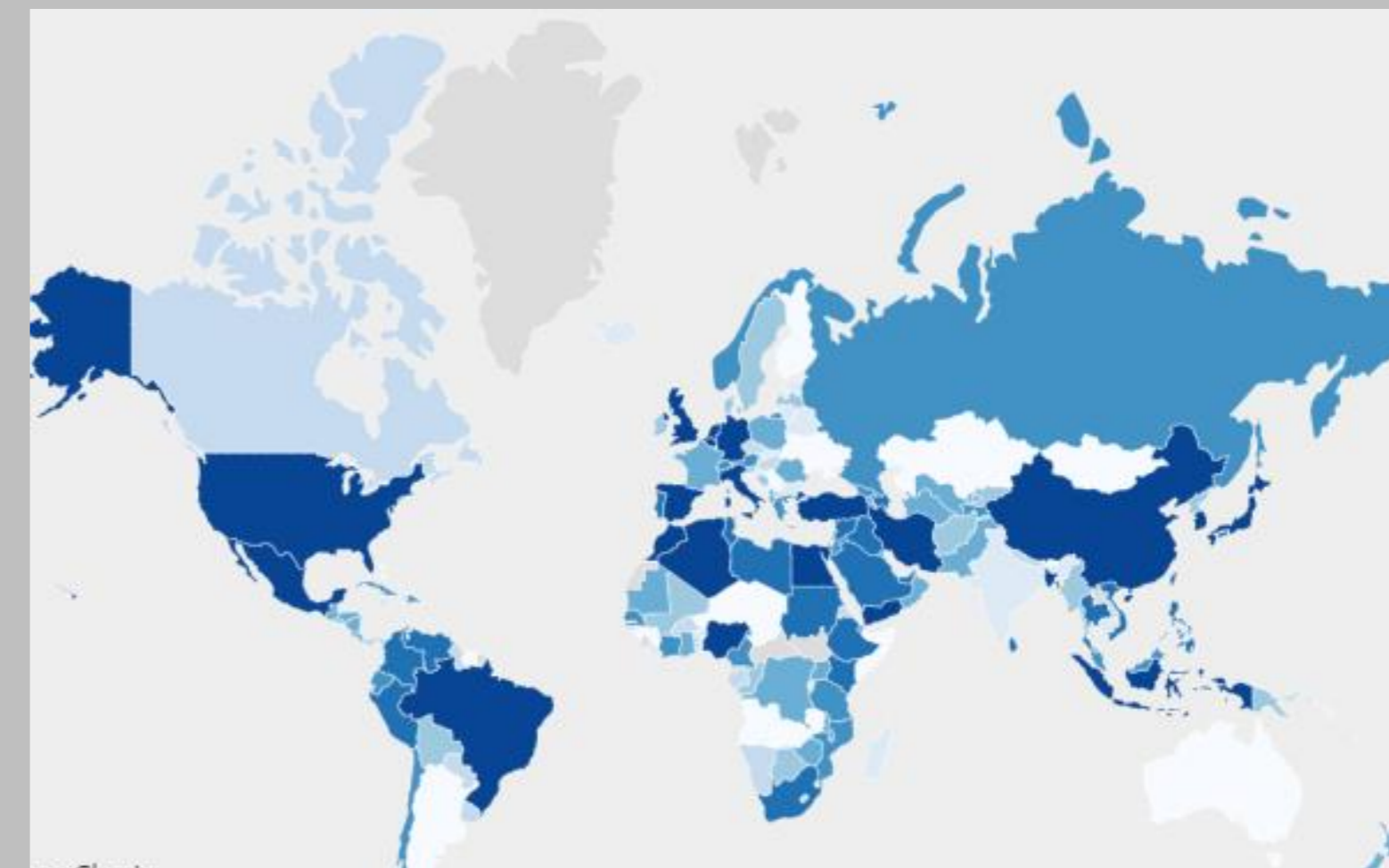
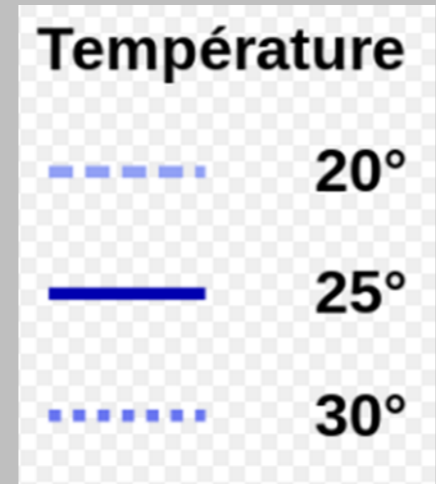


Loading in Winter in Santos :

- temperature 15°C - RH 80% EMC = 15%

Delivery to Algiers two weeks later

- temperature 25°C – RH 70% EMC = 13,5%





TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

MOISTURE (%)

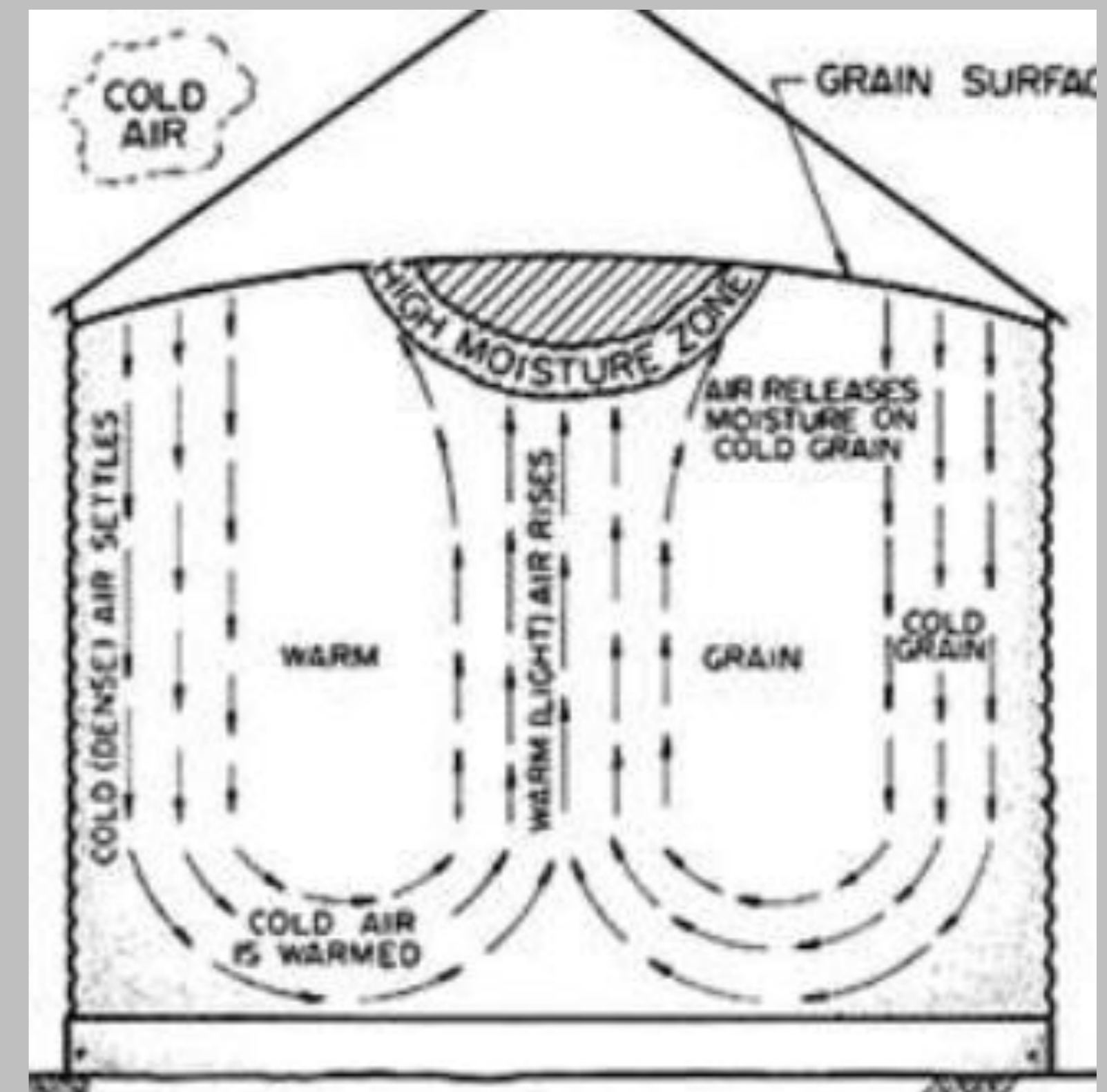
Which means :

- 1,5% of water available for migration (= a migration capacity of more than 400 Mt water of a consignment of 30 000 Mt)

Migration of moisture as per « cold wall effect » (sea water temperature on the hull) and « hot point effect »

➔ high moisture zone

- This excess of available water involves a « chain evolution » and other phenomenon (mold, germination, etc...) which is an exothermic phenomenon = increase of temperature = favorable situation for pest infestation and the condensation phenomenon





TRANSPORTATION OF GRAIN

KEYS FACTORS FOR PRESERVATION AND TRANSPORTATION

WHAT ABOUT INSPECTION ACCURACY ?

Sampling is performed in average.

Example : for a load of wheat of 25 000 Mt, it will be 10 lots each of min. 40 increments, which means a minimum of 400 sampling points.

Inspection companies are thereafter computing an average per hold or average per vessel.

The average can be « in spec » in spite of parts being « off spec »

➔ water migration within the load



Consignment size	Tonnes	0-5000	5001-10,000	10,001 - 25,000	>25,000
Lot size	Tonnes	500	1000	2500	5000
No. of increments per lot	number	min 20	min 30	min 40	min 50
Min bulk aggregate sample per lot	Kilos	20	30	40	50
Max weight of increments	Kilos	1	1	1	1





TRANSPORTATION OF GRAIN

RISKS

Main types of alterations	Main causal factors	Main sources of causes	Main control factors
Germination	Moisture	<ul style="list-style-type: none"> ✓ Inadequate drying at origin ✓ Re-wetting in progress of conversation / transport by : <ul style="list-style-type: none"> • infiltration, • rupture in piping • failure of sealing / ballast • condensation • other events <p style="text-align: center;">(1)</p>	<ul style="list-style-type: none"> ✓ Quality level control of the commodity at origin ✓ Control of the state of facilities of conservation or transport ✓ Ventilation (see use of suitable type of transport mean example super ventilated container for shipments from tropical area – when available) <p style="text-align: center;">(2)</p>
Self heating	Humidity For certain products such as grain meal : compaction factor	<ul style="list-style-type: none"> ✓ (1) ✓ more or less sensitivity of the product 	<ul style="list-style-type: none"> ✓ (2) ✓ Loading height, appreciation of the potential of conservation and knowing the product
Microflora (microbiology, toxins...)	Contamination at origin Favourable factors to multiplication (humidity, free access to fauna etc.)	<ul style="list-style-type: none"> ✓ (1) ✓ Default of protection to the access of the storage transport areas by animals (rodents, birds etc) or cross contamination by mismanagement of stock 	<ul style="list-style-type: none"> ✓ (2) ✓ Fumigation ✓ General hygiene of storage conditions or mode of transport
Oxidation and other degradation of chemical characteristics (example: enzymatic browning.	Moisture Heat	<ul style="list-style-type: none"> ✓ (1) ✓ Other heat sources such as heat fuel/oil or ballast 	<ul style="list-style-type: none"> ✓ (2) ✓ Notification to the carrier of the sensitivity the product to heat for utilising as regards oil heating or to put protection in place in hold
Pollution	Quality defect at origin Failure to monitor and clean up previous storage/transport Failure to control the flow of logistics/handling		<ul style="list-style-type: none"> ✓ Control qualitative level of the commodity at origin ✓ Control the state of facilities of conservation and transportation



TRANSPORTATION OF GRAIN

KEYS RISKS

WATER MIGRATION DURING SEA VOYAGE & CONDENSATION

BASE : SHIPS ARE NOT BUILT TO VENTILATE THE CARGO BUT ONLY THE VOID SPACES

- Water migration : contractual sale norms cannot be assimilated to loss prevention norms
- Condensation (ship sweat or cargo sweat) :
Principle : capacity of air to contain water is lowered as the temperature is reduced

A consignment is loaded under constant pressure of air (7600 mm of Hg) in the following thermal and hygrometry conditions of air :

Loading in Abidjan: Air temperature : 38°C Relative Humidity : 80 % In these conditions, the air contains 0,03168 kg of vapour per m³.

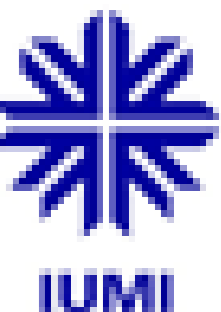
Unloading at Hamburg : Air temperature : -4°C Relative Humidity : 40 % In these conditions, the air contains only 0,0014 kg of vapour per m³.

Difference between the vapour capacities in the air, between expedition and destination, is 0,0354 kg per m³ = natural condensation (in case of 1 000 m³ void space in a hold, natural condensation without ventilation can represent up to 35 liters of condensation water by natural effect ,which can be added water available due desorption from the grain,

Rule is « never ventilate if external dew point is higher than dew point in hold»...

- ➡ From cold temperature areas (cold cargo) to warm atmospheric temperature areas – difficult or impossible to ventilate : risk of cargo sweat
- ➡ From tropical temperature areas (warm cargo) to cold atmospheric temperature areas – risk of condensation is aggravated by decreasing of the EMC point = desorption

For this reason, grain produced and exported from tropical areas (example cocoa beans) always represent a higher risk factor than grain produced and exported from more temperate areas (example wheat)





TRANSPORTATION OF GRAIN

KEYS RISKS

TEMPERATURE

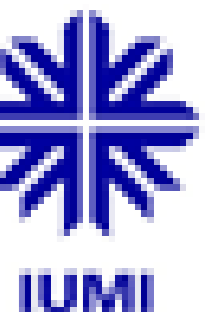
BASE : GRAINS ARE NEVER TRANSPORTED UNDER CONTROLLED TEMPERATURE

However

- ➔ **grain loaded at high temperatures (above 25°C) is a risk factor :**
 - **Infestation, germination, self heating, self combustion... in addition to ship's sweat**

- ➔ **grain loaded at low temperatures (below 0°C) is a risk factor :**
 - **Cargo sweat**

Risk related to the ship : Onboard the vessel, grain that is loaded in a hold next to the engine room and fuel or ballast tanks can be exposed to high temperature (moisture migration, maillard reaction, etc...)

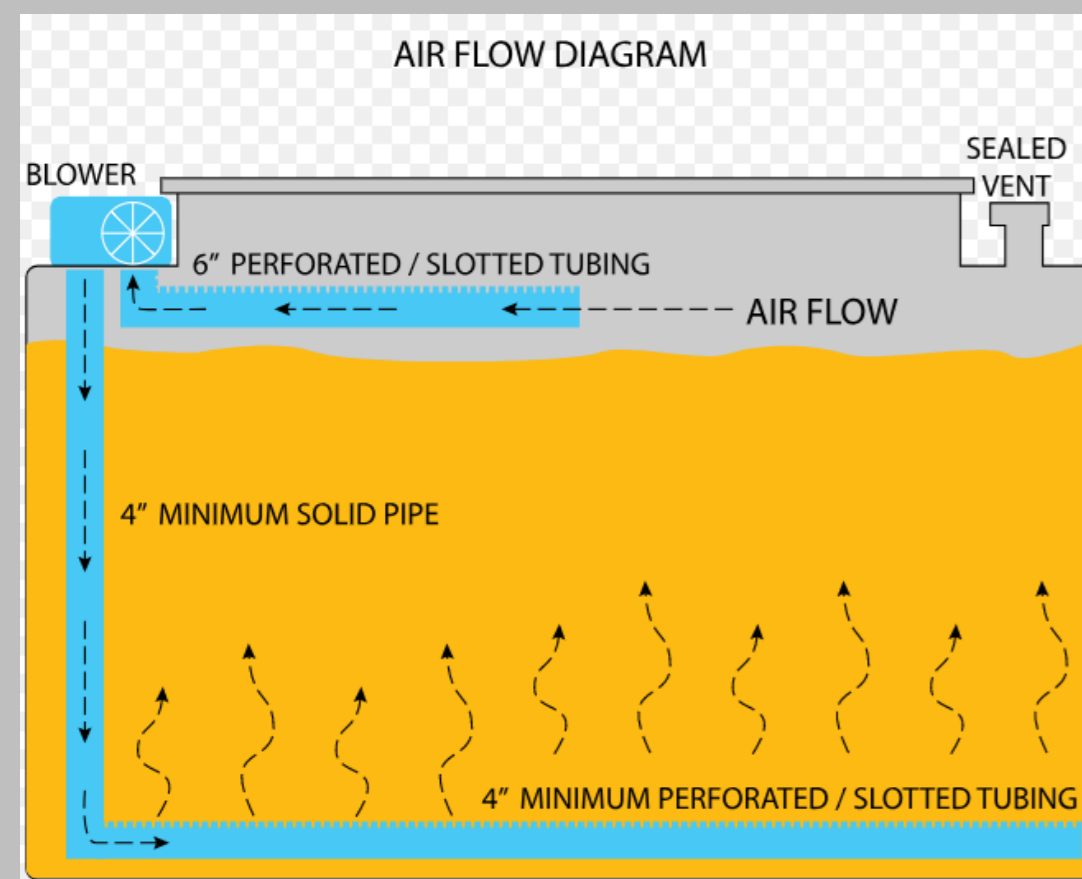




TRANSPORTATION OF GRAIN

KEYS RISKS

FUMIGATION



BASE : FUMIGATION IS CONDUCTED ONBOARD THE VESSEL

Either by phosphine or methyl bromide

(which are usually the only two active agents authorised internationally in grain)

- Efficiency : limited in time : depending on application, level of product used and temperature (usually max authorized for phosphine 15 grams / m³)
- Fumigation is not always sufficient protection (in case of multimodal vessels – disinfection of ventilation ducts, bilges etc... is also recommended)
- Dangerous for humans (IMDG code – exposure limit is varying from country to country – Europe LVE = 0,1 – 0,3 ppm)
- Necessity of gas freeing (gas free certificate) to avoid exceeding the MRL (Maximum Residue Level which can result in a rejection) – Phosphine MRL usually 0,1 mg per Kg

Recommendation :

- Only agree on GAFTA certified fumigation companies
- Refumigation after 30-60 days depending on temperature



TRANSPORTATION OF GRAIN

KEYS RISKS

SELF HEATING - SELF COMBUSTION

**BASE : CEREALS ARE NOT HIGHLY SENSITIVE (EXCEPT MAIZE)
OLEAGINOUS SEEDS AND MEALS ARE HIGHLY SENSITIVE**

Reserve carbohydrate ($C_6 H_{12} O_6$) + Oxygen (O_2) produces heat (plus other gases)

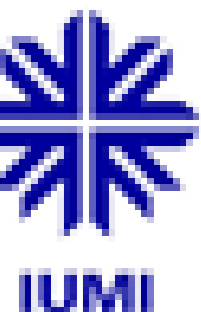
but oxydation of lipids produces much more heat

Illustration

combustion of one gram of glucose produces abt. 15 Kjoules

Combustion of one gram of tripalmitine is producing abt. 3900 Kjoules

Available water (over EMC due to « off spec ») at loading or water migration during voyage drastically accelerates the heating process which can cause self-combustion and fires onboard





TRANSPORTATION OF GRAIN

KEY RISKS

SELF HEATING - SELF COMBUSTION

**BASE : CEREALS ARE NOT HIGHLY SENSITIVE (EXCEPT MAIZE)
OLEAGINOUS SEEDS AND MEALS ARE HIGHLY SENSITIVE**

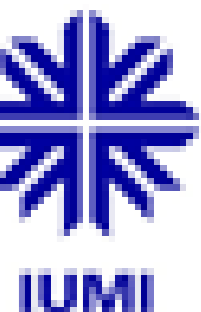
Seed cake is particularly affected as it is concerned by IMSBC depending on moisture and lipid content :

UN1386 - SEED CAKE

- mechanically expelled seeds contain more than 10% of oil or more than 20% of oil and moisture combined
- solvent extraction and expelled seeds contain no more than 10% of oil and when the amount of moisture is higher than 10%, not more than 20% of oil and moisture combined (some exceptions)

class 4.2 (flammable solid) – may self heat slowly and if wet or it contains an important proportion of unoxidised oil, ignite spontaneously.

Cargo must not be loaded if its temperature is 10°C higher than the ambient temperature or higher than 55°C. Obligation to trace the age of the cargo. In case of the increased temperature of the cargo over 55°C, ventilation should be stopped and if the process continues an injection of carbon dioxide into cargo space, etc...





TRANSPORTATION OF GRAIN

KEYS RISKS

SELF HEATING - SELF COMBUSTION

**BASE : CEREALS ARE NOT HIGHLY SENSITIVE (EXCEPT MAIZE)
OLEAGINOUS SEEDS AND MEALS ARE HIGHLY SENSITIVE**

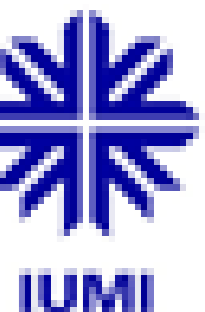
UN2217 - SEED CAKE

- With no more than 1,5% oil and 11% moisture (solvent process extraction)

class 4.2 (flammable solid) – may self heat slowly and if wet or containing an important porportion of unoxidised oil, ignite spontenaously.

cargo must not be loaded if temperature is 10°C higher than ambient temperature or higher than 55°C. Obligation to trace the age of the cargo. In case of the increased temperature of the cargo over 55°C, ventilation should be stopped and if the process continues, injection of carbon dioxide in cargo space, etc...

Particular mention Fish meal : class 4.2 (or class 9 if antioxydant treated)





TRANSPORTATION OF GRAIN

KEYS RISKS

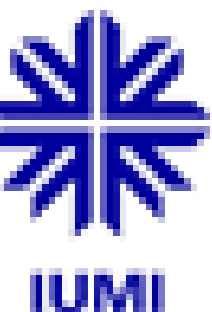
CONTAMINATION - REJECTION

BASE : GRAINS ARE SUBJECT TO CONTAMINATION WHICH CAN RESULT IN REJECTION

- Origin contamination : inherent contamination to production (example wheat ergot which can result in an import rejection – Egypt is very sensitive to this issue)
- Vessel contamination : the issue of previous shipments is sensitive per FOSFA rules regarding the transportation of oil but is also becoming more sensitive for grain
 - reference codes such as GTP (Good trading practices) arising from IDTF (international Data Transport (for) Feed) are influencing new practices / rules related to the safe transportation of grain - www.icrt-idtf.com/en/index.php GAFTA is working on the subject and increasingly strict rules shall soon appear

Example:

- not permitted to use a means of transport previously used for the carriage of waste
- Cleaning rules depending on nature of previous shipments, etc...





TRANSPORTATION OF GRAIN

Conclusion

The transportation of Grain is usually considered low risk practice due to :

- Strict market and inspection framework
- Long shelf life potential and slow evolution of the product

Reality is quite different

As regards to transport risk, the situation is a bit different as thermodynamics are involved during transportation and the transport operation impacts and **may accelerate the life of grains**, mostly due to moisture migration.

In addition, in trade practices and rules, grain is increasingly becoming a more food related product (in terms of food safety) than a dry bulk cargo.... Involving a new generation of risks...



2014 – Brazil loaded on board of the MV « Catastroph »

30 000 MT maize loaded on board of the vessel - 6 600 000 USD

First class inspection company certificate at loading time « in spec »

SPECIFICATIONS	METHODS	RESULTS
MOISTURE MAX 15%	USDA STANDARD	14,82%
TEST WEIGHT 67 KG/HL MIN	USDA STANDARD	75,40 KG/HL
DAMAGED GRAIN MAX 5%	USDA STANDARD	3,40%
BROKEN MAX 5%	USDA STANDARD	1,80%
TOTAL AFLATOXIN MAX 20 PPB	USDA STANDARD	< 20 ppb
AFLATOXIN B1 MAX 10 PPB	USDA STANDARD	< 10 ppb
VOMITOXIN MAX 2 PPM	USDA STANDARD	< 2 ppm



+ Gouvernemental agency for agri. Inspection certifying « in spec » results

= Clean on board BL's

- › The Brazilian Ministry of Agriculture allowed loading to 15% max moisture
- › The first class inspection company certified that 30 000 MT were loaded with a moisture level of 14,8%
- › No water ingress during sea voyage
- › Spot moisture level discovered over 15% at destination in Algeria



Three problems :

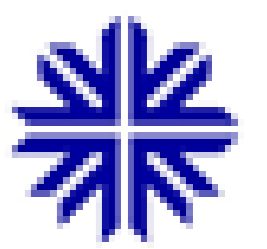
- *For the intended voyage (winter Argentina to warm region and considering the voyage duration), max critical moisture for the voyage was 14,5% Additional 0,3% enabled water migration in maize within hold = mold & self heating process*
- *Investigating in Argentina, we discovered detailed data sheet from inspection company : maize was loaded up to 15,3 / 15,7% but the inspection company issued a certificate **on average basis** which enabled a result complying with legal max moisture.*
- *No ventilation for 20 days (instead of 10 days as normally for fumigation purpose)*

= 4 200 000 USD loss

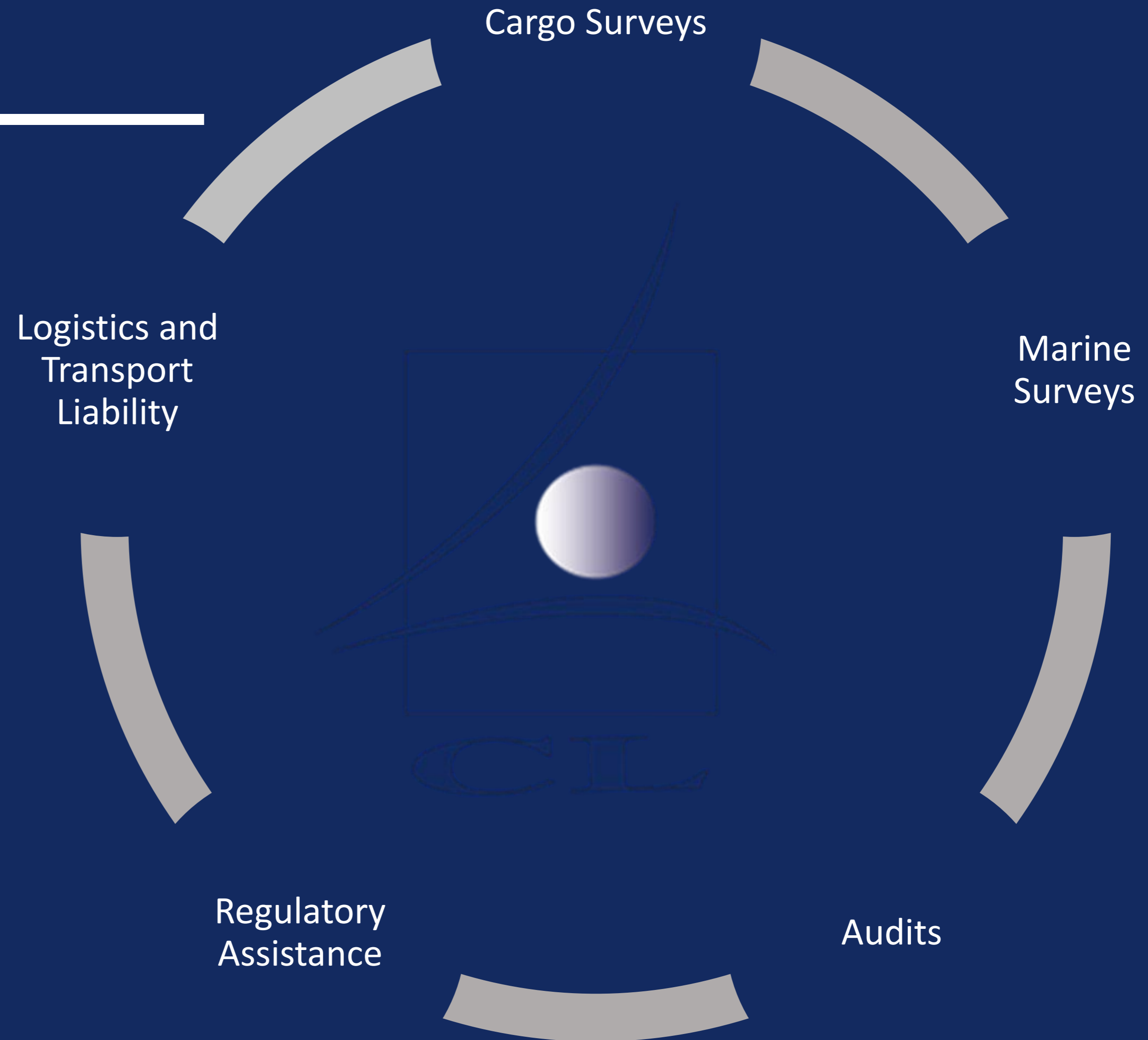




CL SURVEYS



Our services



Our Key Figures



30 years

50 000
surveys

Europe, Russia & China
own offices
&
more than 150 countries
in partnership

Our added value



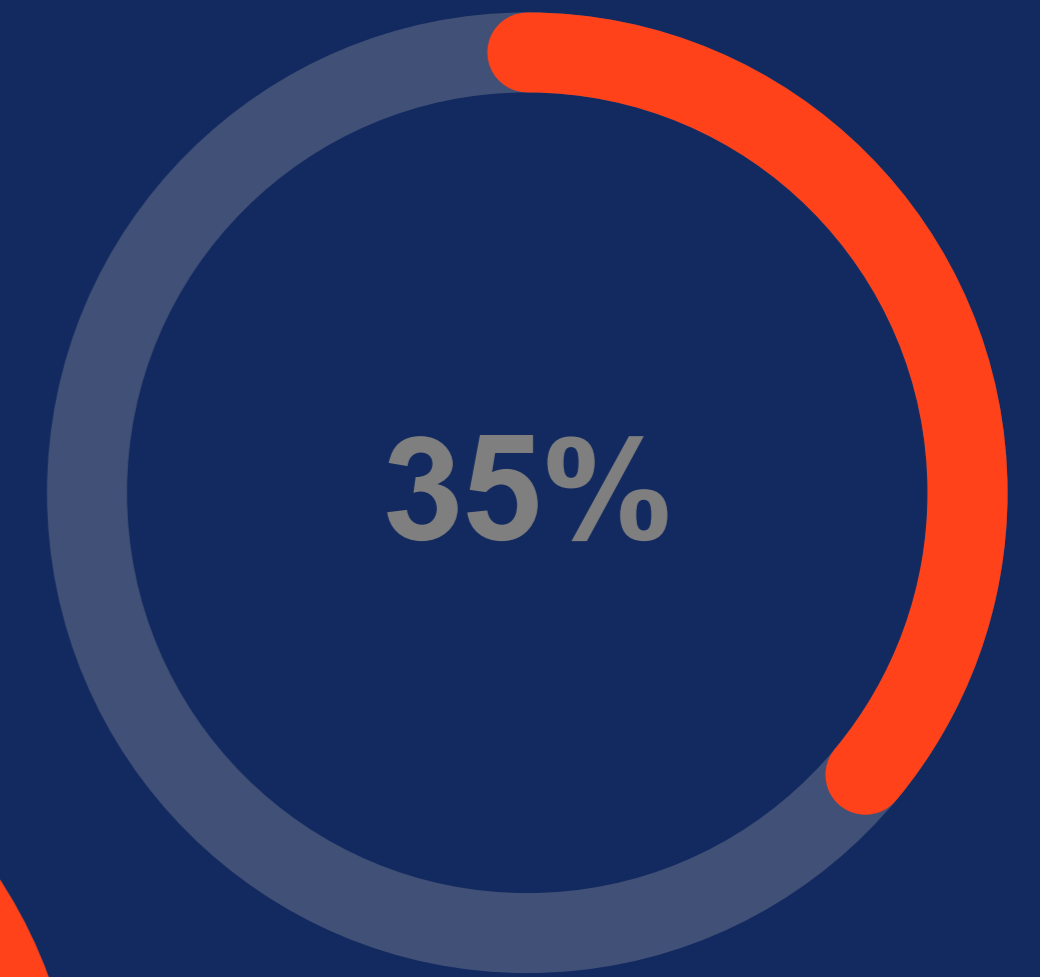
**GRADUATE
DIPLOMAS**



**INTERNATIONAL
EXPERIENCE**



**EQUAL
OPPORTUNITIES
(FEMALE STAFF)**



50%

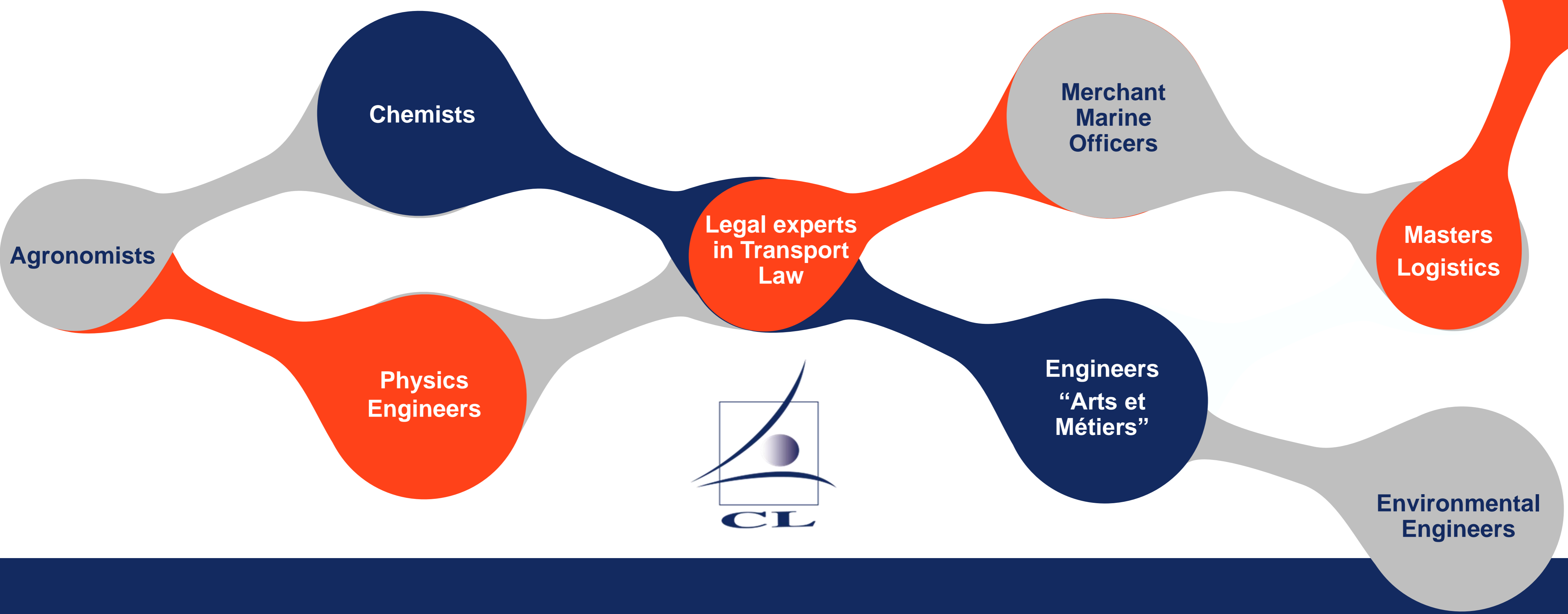
45%

**MORE THAN
10 YEARS
PROFESSIONAL
EXPERIENCE**

**MORE THAN
5 YEARS IN THE
COMPANY**

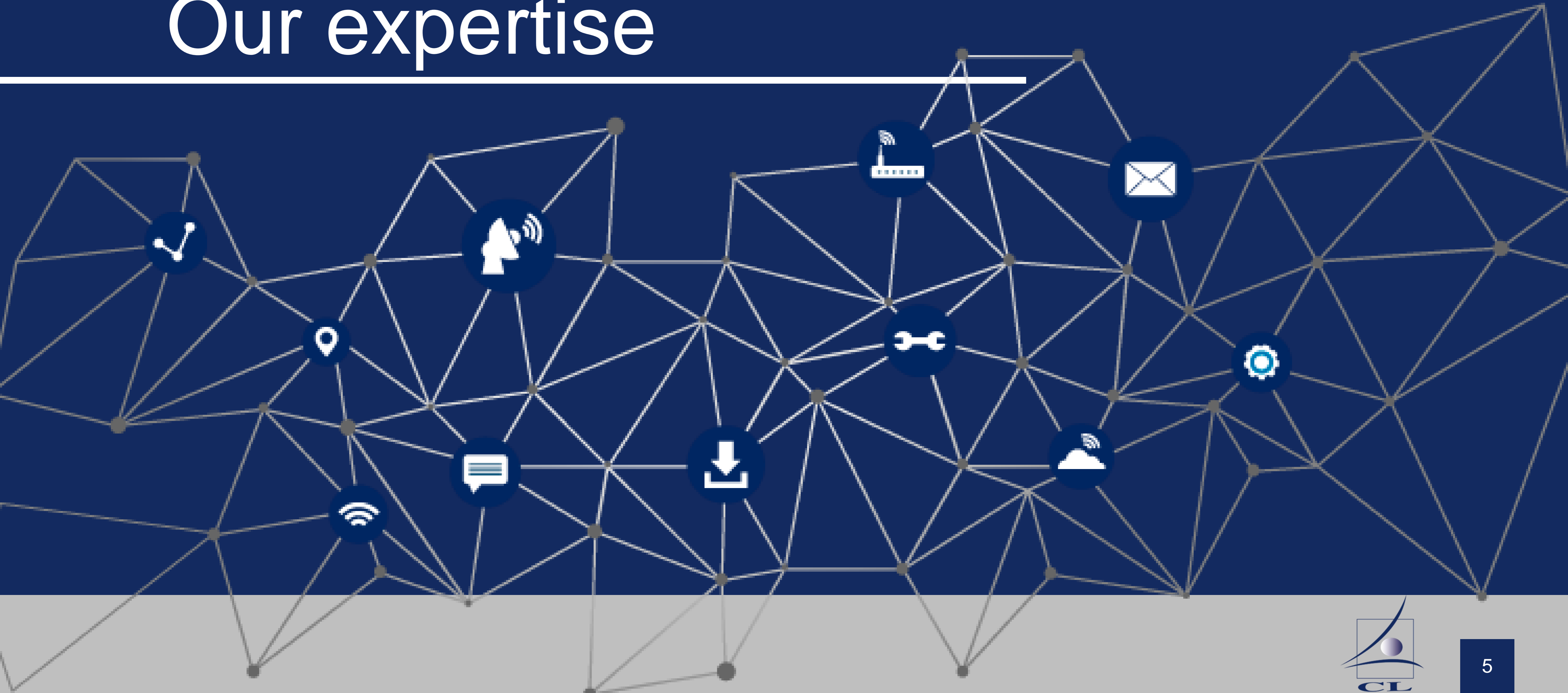


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Our expertise



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