Small-Scale Sanitation in the Nile Delta:

Baseline Data and Current Practices

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Picture on the cover page: Household survey in Beheira Governorate (©Colin Demars)

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Small-Scale Sanitation in the Nile Delta

Baseline Data and Current Practices

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Transect walk with village representatives in El Haderi, Beheira Governorate

ملخص تنفيذي

عبارات رئيسية

- إن نقص بيانات توصيف الواقع (كمرجعية للمقارنة) وكذلك المعاييرالتصميمة لنوعيية مياه الصرف الصحى لقرى الريف في دلتا النيل، يعوق اختيار وتصميم خيارات فعالة من حيث التكلفة في التجمعات التي يقل سكانها عن 5000 نسمة.
- يشير هذا التقرير إلى ندرة البيانات الموجودة بالفعل ويقدم اول بيانات مرجعية لتوصيف الواقع متضمنًة خصائص الصرف الصحي ورواسب الصرف (نواتج تقريغ البيارات)والسماد الحيواني في العزب. تم وصف العوامل والممارسات التي تؤثر على كميات وخصائص مياه الصرف بناء على زيارت ميدانية لأكثر من 30 قرية ودراسات مفصلة في 6 قرى مختارة تم استكمال بيانتها من خلال المقابلات الشخصية.
- تم توفير بعض الأدوات المفيدة للعمل الميداني مثل المبادئ التوجيهية شبه المنظمة للمقابلات والمبادئ التوجيهية للدراسات الاستقصائية للأسر المعيشية (كلها باللغتين العربية والانجليزية ويمكن تحميلها على www.sandec.ch/esriss).
- تتفاوت التكلفة التي يتحملها في الوقت الحالي سكان العزب موضع الدراسة بشكل كبير. ويضطر سكان القرى مستخدمى البيارات التقليدية إلى تحمل تكلفة مرتفعة للغاية تزيد في بعض الأحيان عن 20 مرة قدر الذين تخدمهم شبكة المجاري الحكومية، مما يدل على القدر الكبير من عدم المساواة بين المناطق المحرومة من الخدمات وتلك التي تتمتع بها.
- فيما يخص سعر مياه الشرب، فالنتائج تبين أنه مع تراوح متوسط سعر متر المياه المكعب ما بين 0.7 و1 ج.م. فإن سكان القرى يدفعون اكثر وبشكل ملحوظ عن التعريفة الرسمية. هذا بالإضافة إلى أن فواتير المياه لا ترتبط بشكل مباشر بالاستهلاك الفعلي.
- يتراوح الاستهلاك في القرى موضع الدراسة الثلاث ما بين 60 و 110 لتر/الفرد/ اليوم، ويواجه الناس مشاكل خطيرة تخص البنية الأساسية للمياه؛ فحتى في حالة اتصال معظم الأسر المعيشية بشبكة إمداد المياه فإن أغلبها أبلغ عن مشكلات بمياه الشرب مثل الانقطاع والضغط المنخفض.
- يجب الأخذ في الاعتبار التفاوت الشديد بين التجمعات الصغيرة، فمن الضروري عمل تقييم أولي شامل لكل حالة على حدة لتحديد معايير التصميم والخيارات الأكثر فعالية من حيث التكلفة. يوجد نقص على هذا المستوى في الاحصاءات الموقة و الخاصة ببعض العوامل الحاسمة مثل عدد السكان واستهلاك المياه. ومن العوامل الهامة التي تؤثر في اتخاذ القرار عوامل مثل كثافة وشكل لتجمعات، والقرب من المصارف أو القنوات، و منسوب المياه الجوفية ، ونوعية إمداد المياه أو عدد الحيوانات لكل أسرة معيشية التي تؤثر في التكلفة واختيار البدائل.
- وتتباين المهارات والامكانيات والرغبة في المشاركة من قرية إلى أخرى. ولا بد أن يشترك أصحاب المصلحة الرئيسيون في العملية منذ البداية. ويوصى بشدة بضرورة إجراء مناقشة لخطة الإدارة والتأكد من صحتها قبل الاختيار النهائي للخيارت الفنية.
- ويُرنقص/عدم وجود قياسات للتدفق كقصور شديد بالمنظومة.
- من الوسائل الفعالة لتقليل أحمال الملوثات على المجارى المائية هو إنشاء نقاط للتخلص من رواسب الصرف (نواتج تقريغ البيارات) في شكل وحدات معالجة أولية، ويمكن لمقدمي الخدمات من القطاع الخاص دفع مصروفات بسيطة لكل مرة يتم التصريف على هذه الوحدات لتغطي تكلفتها البسيطة للتشغيل والصيانة .
- يجب مد الدعم الفني للمجتمعات التي تكون على استعداد لدفع تكلفة شبكة مجاري.
- يجب مراجعة قانون 1982/48 كشرط اساسى لمنطقية الاستثمارفى معالجة مياه الصرف الصحى الريفية . إن اللوائح المتشددة "تقضي على" الحلول الناجعة و تبعث على اتخاذ خيارات معقدة ومكلفة لا تعمل على المدى الطويل. إن العامل المقيد الرئيسي هو قيمة الاكسجين الكيميائى الممتص (80 ملليجرام/لتر:COD) الذي يقل بقدر كبير عن مثيلة بمعيار القياسية للاتحاد الأوروبي (ملليجرام125/لتر).
- يمكن استيحاء تجارب بعض الدول مثل الأردن والمغرب التي تلجأ إلى معايير اكثر واقعية (250 ملليجرام/لتر قيمة قيمة الاكسجين الكيميائى COD الممتص في المغرب؛ 300 ملليجرام/لتر قيمة قيمة الاكسجين الكيميائى الممتص COD للمعالجة الحيوية في الأردن. وتتبع المغرب نهجًا تدريجيًا في تطبيق المعاير القياسية الخاصة بها.

إن هذا التقرير هو نتيجة المشروع البحث المصري- السويسري لتطوير أنظمة الصرف الصحي المستدامة Egyptian-Swiss Research on Innovations in Sustainable Sanitation (ESRISS – www.sandec.ch/esriss) وهو مكون بحثى موازٍ لمشروع البنية التحتية المتكامل للصرف الصحي الممول من البنك الدولي Integrated Sanitation and Sewerage Infrastructure Project (ISSIP) ويشرف على هذا المكون البحثى المعهد الفيدرالي السويسري لعلوم البيئة والتكنولوجيا في مجال المياه (Eawag) بالاشتراك مع الشركة القابضة لمياه الشرب والصرف الصحي المصرية (HCWW) وبتمويل من وزارة الاقتصاد السويسرية. و يخاطب هذا التقرير بشكل اساسى كل اصحاب المصلحة في قطاع مرافق الصرف الصحي ،و متخذي القرار والهيئات الحكومية والمستشارين والأكاديميين، الذين يتناولون مرافق الصرف الصحي في المناطق الريفية والصرف الصحي صغيرة الحجم بصفة عامة، و استكمالاً للتقرير الأول لمشروع ESRISS: "مرافق الصرف الصحي على نطاق صغير : التحديات والطرق للأمام" وكذلك نقاط البحث العشر لملخص السياسات ويضع الأساس للتقرير التالي: "المرافق الصحية في دلتا النيل: تحليل تدفق المواد". ويمكن تحميل كل الوثائق من الصفحة الخاصة بـ ESRISS www.sandec.ch/esriss

الأهداف

يُعتبر نقص بيانات توصيف الواقع (كمرجعية للمقارنة) وكذلك المعايير التصميمة لنوعية مياه الصرف الصحى لقرى الريف فجوة كبرى في تطوير استراتيجيات المرافق الصحية السليمة اللتجمعات أقل من 5000 نسمة. وعادةً تشمل تلك البيانات خصائص وكميات المياه المستعملة التي تحتاج للمعالجة سواء كان ذلك في شكل صرف صحي أو رواسب الصرف (نواتج تفريغ البيارات)، غير أن التفاوت الكبيربين العزب والقرى في دلتا النيل ؛ يحول دون تعريف قيم يمكن تطبيقها على كل هذه التجمعات، وعوضًا عن ذلك فإن إعداد بيانات توصيف الواقع (كمرجعية للمقارنة) في هذا السياق يعني فهم الممارسات الحالية في المرافق الصحية، والعوامل المؤثرة على كمياتها وخصائصها ومدى هذا التأثير.

وقد تقرر أن يضع مشروع ESRISS أول بيانات لتوصيف الواقع بهدف تحقيق التالي:

1. جمع كل المعلومات المتوفرة والإشارة لها في تقرير واحد.
2. استكمال مجموعة البيانات مع القيام بتحاليل خاصة بالمشروع لعينات الصرف الصحي ورواسب الصرف والسماد الحيواني.
3. وصف الممارسات الحالية لمرافق الصرف الصحي في قرى دلتا النيل بما فيها من سلوك الأسر المعيشية واعمال تفريغ البيارات.
4. فهم العوامل المؤثرة في خصائص وكميات مياه الصرف الصحي.
5. وصف ممارسات إعادة استعمال المياه والمغذيات (الاسمدة الحيوانية).
6. تقييم التدفق المالي المتعلق بالمرافق الصحية في الوضع الحالي.

نتائج التحليل و نموذج التدفقات الصرف الصحي مذكورة في تقرير "تحليل تدفق المواد".

المنهجية

تم تنفيذ الأنشطة التالية لتحقيق أهداف الدراسة:

- استعراض التقارير والوثائق الخاصة بالمرافق الصحية في الريف في مصر
- اختيار القرى الصالحة لإجراء الدراسة الأولية

- إجراء مقابلات شبة منظمة مع أصحاب المصلحة الرئيسيين في مجال المرافق الصحية:

(أ) سلطات القرية (العمدة وشيخ البلد)؛ (ب) القائمون على تفريغ البيارات؛ (ج)المزارعون؛
(د)مشغلي شبكة الصرف؛ (ه) ملاك المباني غير السكنية.

- المسح الميدانى للمنازل
- الملاحظة ، اثناء الجولات الميدانية
- تجميع العينات، واعادها بشكل جزئى باستخدام المختبرات الحقلية المحمولة

تقع كل القرى التي تم زيارتها في نطاق مشروع البنية التحتية المتكامل للصرف الصحي الذي يموله البنك الدولي ISSIP (المناطق المتاخمة لترعتى المحمودية وميت يزيد) على مدى ثلاث محافظات (البحيرة والغربية وكفر الشيخ)، وتقع كل القرى التي تمت دراستها في محافظة البحيرة. وقد تم تنفيذ المسح الميداني بالشراكة مع الشركة القابضة لمياه الشرب والصرف الصحي المصرية HCWW والشركات التابعة لها بدعم من مشروع البنية التحتية المتكامل للصرف الصحي الذي يموله البنك الدولي ISSIP PM/TA.

النتائج والتوصيات

يشير التقرير إلى ندرة المعلومات الموجودة كما يتم وضع أول بيانات أساسية متضمنة توصيف مفصل للصرف الصحي، ورواسب الصرف، والسماد الحيواني في العزب. تم وصف العوامل والممارسات المؤثرة على كميات وخصائص مياه الصرف الصحي بناءً على زيارت لأكثر من 30 قرية ودراسات مفصلة تخص 6 قرى مختارة، وقد تم استكمال تلك الدراسات بالعديد من المقابلات مع أصحاب المصلحة في مرافق الصرف الصحي واثناء الجولات الميدانية. وتضمن العمل الميداني: (ا) 122 دراسة استقصائية للأسر المعيشية؛ (ب) 5 مقابلات مع القائمين بتفريغ البيارات؛ (ج) 14 مقابلة مع المزارعين؛ (د) مقابلاتان مع أشخاص مسئولة عن صيانة المجاري؛ (ه) 3 مقابلات مع أشخاص مسئولة عن المباني غير المنزلية. يعطي هذا العمل صورة واضحة عن الممارسات الحالية، ويسلط الضوء على التنوع الكبير في الملامح المميزة للقرية في دلتا النيل ويعرف بدقة الموقف الخالى في القرى الست محل البحث. يوفر هذا التقييم للوضع الحالي قاعدة لمشاريع الصرف الصحي المستقبلية؛ وقد أسهم جزء منه فعلياً في الدفعة الأولى من المكون اللامركزي لمشروع البنية التحتية المتكامل للصرف الصحي الذي يموله البنك الدولي Integrated Sanitation and Sewerage Infrastructure Project (ISSIP). وللوصول على البيانات الأساسية الكاملة للمرافق الصحية في الريف في جميع أنحاء مصر، يوصى بتكرار الدراسات الميدانية في الصعيد حيث يختلف الوضع عن الدلتا. هذه البيانات ترسي اساس قوياً لتطوير السياسات والمبادئ التوجيهية على المستوى القومى.

تم تطوير ادوات مفيدة للعمل الميداني مثل النماذج الارشادية شبه المنظمة للمقابلات، النماذج الارشادية للمسح الميدانى للاسر المعيشية (متاح بالكامل باللغتين العربية والإنجليزية) وبروتوكول تجميع العينات، واعادها بشكل جزئى باستخدام المختبرات الحقلية المحمولة، وهم يشكلون سويًا حزمة أدوات للتقييم المبدئي للتجمعات الريفية الصغيرة.

خصائص وكميات مياه الصرف الصحي

اظهرت حملات تجميع العينات تفاوت خصائص وكميات مياه الصرف على هذا النطاق، ومن الواضح أن مياه الصرف في الريف أكثر تركيزًا من مياه الصرف في الحضر مما يجب أخذه في الاعتبار في التصميمات المستقبلية. أما بالنسبة لرواسب الصرف (نواتج تفريغ البيارات) فإنها من خمس إلى عشر مرات أكثر تركيزاً من متوسط الصرف الصحي لمثل هذه القرى.

يسلط تحليل الممارسات الحالية الضوء على العوامل التي تسبب هذا التباين الشديد. يميل سكان القرى الذين يعتمدون على نظم المرافق الصحية الموجودة في الموقع (البيارات) إلى الحد من استهلاك المياه حتى يقل معدل

تكرار التفريغ. تظهر الدراسات الاستقصائية ان نصف المياه الرمادية التي ينتجها مالكي البيارات يتم صرفها مباشرة في البيئة المحيطة (خارج البيارات) ولذا لا تسهم في تخفيف رواسب الصرف. لهذا السبب يزيد إنتاج مياه الصرف بشكل ملحوظ عند إنشاء شبكة مجاري. وتتقلص هذه الزيادة في بعض القرى بسبب عند عدم كفاية إمدادات المياه (ضغط منخفض اوانقطاعات).

إن عمل تحاليل إضافية لعينات من الصرف الصحي ورواسب الصرف في العزب سيأتي بفائدة كبيرة على بيانات توصيف الواقع (كمرجعية للمقارنة). يجب تنظيم حملات إضافية لتجميع العينات في عدد أكبر من القرى وكذلك على مدى أطول من الزمن. فهم التباين الموسمي بالإضافة إلى الذروة والتباين اليومي يجب دعمه عن طريق جمع بيانات أكثر.

في المجمل لوحظ أن قياسات التدفق تشكل قصورًا رئيسيًا فى مصروستستفيد أي بنية تحتية جديدة لمياه الصرف من رصد للتدفق عن كثب، مما سيساعد بدوره في وضع تصميم أفضل لوحدات معالجة إضافية. يجب توثيق ورصد أي مشروع حتى تُسنخلص الدروس المستفادة والبيانات الموثوق فيها؛ وهو مايصعب وجوده حالياً.

أهمية تقييم كل حالة على حدة

توضح هذه الدراسة عدم التجانس الشديد بين التجمعات الصغيرة في دلتا النيل. وهذه الفروق في الكثافة، والشكل، والقرب من المصارف أو القنوات، ومنسوب المياه الجوفية، ونوعية إمدادت المياه، وعدد الحيوانات لكل أسرة، تؤثرعلى الكيفية التي يجب أن يكون عليها تصميم نظام المرافق الصحية وكيفية اختيارات البديل الأكثر فعالية من حيث التكلفة. تؤثر تلك العوامل على وجه الخصوص بشكل كبير على كميات وخصائص مياه الصرف التي يجب معالجتها وعلى تكلفة نظام شبكة الصرف الصحى لكل فرد. لذا يوصى باتباع نهج يقوم على دراسة كل حالة على حدة للتخطيط واختيار التقنيات المناسبة. لذا فانه من الضرورى القيام بتقييم مبدئى لكل موقع (انظر أيضًا التقرير "التحديات والطريق للأمام" والتقرير "تحليل تدفق المواد" اللذان يفصلان المؤشرات التي يجب جمعها لكل موقع.

يجب أن يشترك أصحاب المصلحة الرئيسيين في مرافق الصرف في القرى في العملية منذ البداية. ويوصى بشدة أن تناقش وتحقق خطة الإدارة المستقبلية قبل أن يتم تحديد الاختارات التقنية النهائية. من عوامل الفشل الرئيسية لإنشاء بنية تحتية هو عدم معرفة من سيقوم التشغيل والصيانة أو من سيقوم بدفع التكلفة، وما هي المهارات المطلوبة، ومن سيوفر التدريب. العمل بالتعاون مع المجتمع وأصحاب المصلحة في المرافق الصحية المحلية هو شديد الأهمية للصرف الصحي في التجمعات الريفية الصغيرة.

تبين دراستنا عدم وجود إحصائيات موثوق فيها أوأرقام موثوق في صحتها بخصوص عوامل حاسمة مثل عدد السكان، واستهلاك المياه، وعدد الحيوانات. وفي العادة يختلف عدد السكان الحقيقي عن التعداد الرسمي بشكل كبير. يوفر التقييم الأولي الشامل مؤشرات لتصميم محددة وهي عامل رئيسي لحساب التكلفة الفعالة حيث إنها تسمح بتحديد الابعاد/السعات بشكل مقارب بقدرالإمكان للاحتياجات. السماد الحيواني والملوثات السائلة لمصانع منتجات الألبان يجب أخذها في الاعتبار كأجزاء من نظام المرافق الصحية. في تلك التجمعات الريفية يرتبط بشدة مياه الصرف والسماد الحيواني ومياه الامطار ويجب معالجتها بشكل إجمالي. وبالتوازي يجب ايضاً إدارة المخلفات الصلبة في العديد من تلك القرى.

كَلَف وضع المقاييس والسعات التصميمية الخاطئة للبنية التحتية نتيجة عدم مراعاة الموقف الفعلي على الأرض في الماضي مبلغ كبير من المال في التكاليف الاستثمارية وتكاليف التشغيل وهدد امكنية تكرار النظم الصغير(الامكزية). إضافةً إلى ذلك فإن محطات المعالجة المبالغ في سعاتها تخاطر بالوصول للعمرالافتراضي لمكوناتها قبل وصولها إلى سعتها التصميمية بكثير؛كما أن المبالغة في سعاتها قد تؤدي ايضاً إلى انخفاض أدائها. يتفاوت التطور/النمو في العزب بشكل كبير ويعتمد على عدد من العوامل التي يصعب التنبؤ بها بشكل يؤدي إلى تباين كبير في النمو السكاني. هناك احتياح للاستخدام وحدات نمطية (تكرارية) مرنة لمواجهة عدم القدرة على التنبؤ بالتطورات المستقبلية.

استهلاك المياه

يمكن لقراءات عدادات المياه على مدى فترة لا تقل عن شهر واحد (تشمل على الاقل ثلاثة قراءات للعداد) الحصول على تقييم واقعي لاستهلاك المياه، فلا يمكن الاعتماد على السعر الذي تدفعه الأسرة المنزلية مقابل المياه حيث إن فواتير المياه في الكثير من الأحيان غير مرتبطة بشكل مباشر بالاستهلاك المبنى.

يتفاوت استهلاك المياه في القرى الثلاث محل الدراسة من 60 إلى 110 لتر للفرد في اليوم. يفسر هذا التفاوت عاملان رئيسيان: (ا) تميل الأسر المعيشية التي تمتلك نظام صرف صحي في الموقع (بيارات) إلى تقليل استهلاك المياه حتى تقلل من امتلاء البيارة؛ (ب) نوعية نظام إمداد المياه (الانقطاع والضغط). يواجه سكان القرى مشاكل حقيقية في البنية التحتية للمياه. حتى في حال تمتع معظم الاسر المنزلية بوصلات إمداد المياه إلا إن معظمهم يقرون بمشاكل في مياه الشرب مثل الانقطاعات والضغط المنخفض. في ثلاث قرى (قشارة وكوم النوس وحضري) 60-95% من أعضاء الاسر المنزلية الذين شاركوا في المقابات خلال المسح الميدانى يعانون من انقطاعات طويلة ومتكررة. كذلك يعانى 70-100% من الاسرالمنزلية في هذه القرى، من مشاكل في ضغط المياه. معظم منازل الاسر المنزلية مجهزة بمضخة والتي تكون في بعض الأحيان ضرورية حتى للدور الأرضي. ويُعد الوضع أفضل في قابيل وحمامي حيث يشكو 50% من االسكان من الضغط والانقطاع. اما في منشية ناصر التي تقع بالقرب من محطة مياه الشرب فإن الوضع أفضل بكثير. في كل قرية تقوم بعض الاسر المنزلية (25 إلى 70%) بجلب مياه من مصادر أخرى غير مياه الصنبور المنزلى مثل الآبار أو القنوات (لأغراض الغسيل). يقوم الكثيرون بغسيل الملابس مع/أو غسيل الأطباق خارج المنزل وتصريف المياه في الشارع أو في المجارى المائية القريبة (مصرف/ترعة).

تكلفة الصرف الصحي

تبين هذه الدراسة أن التكاليف التي يتحملها سكان القري موضع الدراسة في الوقت الحالي مقابل مياه الشرب والصرف الصحي متفاوتة بشكل كبير. وتظهرالتكاليف المرتفعة فى حال سكان القرى المعتمدين على البيارات التقليدية والتي قد تصل في بعض الأحيان إلى 20 مرة أكثر ممايتحملة هؤلاء الذي يتمتعون بخدمة نظام شبكة الصرف الصحى الحكومية. فعلى النقيض يكون المبلغ المدفوع في فواتير المياه مقابل خدمات الصرف الصحى بسيط. ويبين ذلك قدر كبير من عدم المساواة بين المناطق المحرومة والمناطق التي تتمتع بخدمات الصرف الصحى .

أما بالنسبة لسعر مياه الشرب فإن النتائج تبين أن متوسط سعر متر المياه المكعب يتراوح بين 0.7 و1 ج.م. للمتر المكعب وإن سكان القرى يدفعون أكثر بكثير من التعريفة الرسمية. كما تبين كذلك أنه على وجه العموم لا ترتبط فواتير المياه بشكل مباشر باستهلاك المبنى. ويوصى بالتحقق بانتظام من قراءات المياه من عدد من عدادات المياه بالمقارنة بفواتير المياه الخاصة بتلك القراءات وما يتم حسابه في النهاية على مستوى الشركة التابعة. أما على الجانب الإيجابي فإنها تبين أن الأفراد على استعداد لدفع ما يفوق التعريفة الرسمية.

يشكل تفريغ البيارات حملاً ثقيلاً على ميزانية الأسر المنزلية في القرى التي تخدمها مثل تلك النظم في الموقع.فرحلة واحدة من شاحنة إفراغ خاصة تكلف 25 جنيهًا في المتوسط. وتكون الشاحنات العامة عموما أرخص ولكنها نادرة وتكون دئماً موجودة فى القرية الأم. ولذا يسيطر مقدمي الخدمة الخاصة على هذا العمل. ويكون معدل التفريغ مرتفع (في المتوسط كل 10-30 يوم). وتقوم الشحنة بحوالي 2-3 رحلة للبيارة الواحدة في المتوسط للقرية. وتكون النتيجة تكلفة مرتفعة ما بين 7 و28 جنيهًا للفرد في الشهر في المتوسط للقرى محل الدراسة.

قررت الكثير من المجتمعات في ظل هذا الوضع إنشاء شبكة المجاري "غير الرسمية" خاصة بها. تبلغ التكلفة في المتوسط حوالي 530 جنيهًا للأسرة الواحدة للخطوط الرئيسية و550 جنيهًا للأسرة للتوصيل للاسرة. توضح البيانات أن التكاليف الاستثمارية يمكن استرجاعها خلال مدة من عدة شهورالى ثلاث سنوات فقط حسب وضع القرية. وبالتأكيد سيزيد السعر حال قيام سكان القرى بإنشاء شبكات مجاري سطحية بشكل سليم. ومع ذلك وعلى المدى المتوسط وفى معظم الحالات ستظل بالتأكيد أكثر فعالية في التكلفة من الاحتفاظ بنظام البيارات. يجب عقد مقارنات مالية لكل حالة على حدة لتشجيع سكان القرى على الاستثمارفى ذلك. واذا كانت تكلفة الاستثمار مرتفعة

قياسًا لدفعها دفعة واحدة، فيمكن الأخذ في الاعتبار آليات (التاجير التمويلى) التقسيط على مدفوعات شهرية تقل عن المبلغ الذي يتم دفعه مقابل تفريغ البيارة.

ممارسات إعادة الاستخدام

فيما يتعلق بإعادة استخدام المياه والمغذيات فإن هذه الدراسة تبين وعي المزارعين المصريين بمنافع استعادة المغذيات والقيمة الاقتصادية للسماد العضوي والحمأة. ويتم استعمال السماد العضوي والحمأة الجافة على نطاق واسع ويتم شرائهما في بعض الأحيان، ويتم استخدامهما حتى الآن كعنصر مكمل للأسمدة الكيماوية التي تدعمها الحكومة. ولوحظ كذلك إعادة استخدام مياه الصرف في تربية الأحياء المائية. ويُعد العائق الرئيسي فى إعادة استخدام المغذيات والمياه المستعملة المعالجة هو النقل والتخزين خاصةً في حالة الأسمدة الحيوانية السائلة.

يوجد اهتمام شديد بالأسمدة العضوية: الحمأة و الأسمدة الحيوانية والسماد الطبيعي (ناتج الكمر) مما يسلط الضوء عن مدى احتياج المزارعين المصريين. يجب توجيه اختيار نظم المرافق الصحية صوب إنتاج مواد أسمدة ذوات نوعية جيدة تحافظ على المغذيات. تتناسب ألانظمة الصغيرة (الامركزية) بشكل خاص مع هذا الهدف حيث إن الحمأة في التجمعات الصغيرة لم تتلوث بالأنشطة الصناعية ويمكن لأهل القرى أنفسهم إعادة استخدام المنتج في الموقع ذاته. لذا يكون من المهم أن يتم إنتاج حمأة مثبتة بشكل كبير و تعزيز إنتاج سماد عضوي(الكمر) ذو نوعية جيدة على مستوى المزرعة.

في كل من القرى ذوات المرافق الصحية الموقعية (البيارات) وتلك ذوات شبكة الصرف الصحي، تصل نسبة الصرف من المخلفات الحيوانية السائلة التى تصب على أنظمة الصرف الصحي إلى 25% (0 - 50% بناء على الأبحاث في 6 قرى). تقل هذه الكمية في القرية الت بها شخص مسئول عن صيانة شبكة الصرف الصحى بسبب وجود قاعدة تمنع مثل هذا النوع من الصرف (حوالي 9% في كوم النوس، البحيرة). يقوم معظم المزارعون بجمع المخلفات الحيوانية السائلة بشكل منفصل ولكن لا يستعمله معظمهم بسبب عوائق النقل. ويوصى بتنظيم خدمة لجمع السماد على مستوى القرية؛ ويمكن خلط المخلفات الحيوانية السائلة بالنفايات العضوية في مصفوفة كمر السماد العضوي أو تخزينها في صهريج حتى يمكن نقلها آليًا للحقول في الوقت المناسب. يمكن أن تقترن مثل هذه الخدمة بجمع النفايات الصلبة و/أو صيانة نظام(أنظمة) شبكات الصرف. هذا قد يؤدى الى انشاء كيانات تقوم بتقديم الخدمات البيئية المتكاملة .تتوفر خدمات جمع النفايات الصلبة وصيانة شبكة المجاري بالفعل في العديد من القرى.

إذا أمكن فإنه يجب إعادة استخدام المياه المعالجة مباشرة في الري دون المرور عبر المصارف الملوثة. ويوصى ببناء بركة صغيرة كخطوة لزيدة المعالجة (معاجة اضافية) يمكن للمزارعين الضخ منها مباشرةً. ويجب استخدام برك تربية الأحياء المائية حيثما وجدت كخطوة للمعالجة النهائية.

إدارة رواسب الصرف

تحسن مفهوم إدارة رواسب الصرف وأعمال تفريغ البيارات يوفر قاعدة لضم هذا القطاع إلى منظومة الصرف الصحي في المستقبل. المقابلات و المسح الميدانى اعطى نظرة على التكلفة التي يتحملها السكان حاليًا مقابل المرافق الصحية. كما اظهرت الجهود التي تبذلها المجتمعات المحلية لحل معظم مشكلات الصرف الصحي الملحة؛ مثل، التكلفة المرتفعة لإفراغ البيارات، والطفوحات الزائدة، وتشبع التربة، وارتفاع مياه الرشح فى المباني.

يتم تفريغ البيارات ميكانيكيًا عن طريق الشاحنات التي تنقل وتفرغ رواسب الصرف في المصرف القريب. وبالرغم من أن مجالس القرى تمتلك في العادة شاحنة واحدة إلا أن معظم الشاحنات هى ملكية خاصة. لذا فإن تفريغ البيارات في الأساس عمل تجاري خاص غير رسمي يعتبر فيما يبدو عمل مجدي.

ويعتبربناء نقاط للتخلص السليم من رواسب الصرف تتضمن وحدة معالجة أولية واحدة من الطرق ذات التكلفة الفعالة لتقليل أحمال الملوثات على المجارى المائية . ويمكن لمقدمي الخدمة من القطاع الخاص دفع رسوم صغيرة مقابل كل مرة يتم فيها التفريغ والتي يمكن ان تغطي التكلفة البسيطة للتشغيل والصيانة .

تقدم هذه الدراسة متوسطات لخصائص رواسب الصرف، فنتائج حملات جمع العينات متباينة بشكل كبير حيث إن خصائص رواسب الصرف تتأثر بعوامل مختلفة خاصةً: (ا) وسيلة التفريغ؛ (ب) مدة البقاء في البيارة؛ (ج) التفاعل مع المياه الجوفية. لا تزال الكمية الكلية لناتج رواسب الصرف غير واضحة بسبب صعوبة قياس قدر التسرب للداخل أوللخارج في البيارات. بالإضافة إلى ذلك فإن مقدمي الخدمة من القطاع الخاص لا يحتفظون بسجلات بحيث يصبح من الصعب تقدير عدد الرحلات على مستوى القرية في الشهر الواحد. هناك حاجة لمزيد من الرصد حتى يتوفر مؤشرات تصميم سليمة على مستوى القرية.

المبادرات الخاصة

تكشف هذه الدراسة عن كيفية تطوير المواطنون والمجتمعات بشكل مستقل لاستراتيجيات التكيف مع الواقع بأكثر الوسائل فعالية في التكلفة. يبذل هؤلاء الذين يعتمدون على البيارات أقصى جهدهم لتقليل تكرار عدد مرات التفريغ (على سبيل المثال؛ إضافة الملح لزيادة التسرب للداخل، صرف المياه الرمادية في الشوارع). وبالرغم من ذلك فإن الكثير من المجتمعات قررت جمع مبلغ من المال لبناء شبكة مجاري بدائية "غير رسمية" حتى يتم إزالة حمل البيارت (تكرار مرات التفريغ، التكلفة المرتفعة، الحد من استهلاك المياه). للأسف فإن نقص الخبرة الفنية في العادة يجعل من هذه المبادرت البناءة مصدرًا للمشاكل الإضافية.

ويوصى باستغلال تلك المبادرات الخاصة لدعمها وتحسينها. ويجب مد العمل بالقرار الذي اتخذته الشركة القابضة لمياه الشرب والصرف الصحي المصرية HCWW عام 2012 تحت رعاية معالي الوزير عبد القوي خليفة لتوفير الدعم الفني للمجتمعات التي تكون على استعداد للدفع مقابل إنشاء شبكة مجاري. يمكن للحكومة أن تتخذ من أعمال تفريغ االبيارات الخاصة المتطورة أساسًا لتحسين الممارسات الحالية وتوفير نقاط سليمة للتخلص.

إن بناء هاضمات الغاز الحيوي التي يتم تغذيتها بالمحلفات الحيوانية والمياه السوداء (مياه المرحاض) وذلك عند توفر الماشية والمساحة كما هو الحال في الصعيد وشمال الدلتا هو بديل مبشر. تظهر التجربة أن العديد من الأسر المنزلية على استعداد لاستثمار عدة آلاف فيها.

تعديل القوانين واللوائح

يجب مراجعة قانون 1982/48 كشرط اساسى لمنطقية الاستثمارفى معالجة مياه الصرف الصحى الريفية و. إن اللوائح المتشددة "تقضي على" الحلول الناجعة و تبعث على اتخاذ خيارات معقدة ومكلفة لا تعمل على المدى الطويل. إن العامل المقيد الرئيسي هو قيمة الاكسجين الكيميائى الممتص (80 ملليجرام/لتر:COD) الذي يقل بقدر كبير عن مثيلة بمعيار القياسية للاتحاد الأوروبي (ملليجرام125/لتر) كما هو موضح في الملحق 19. كما يُعد مستوى الأكسجين المذاب (< 4 ملليجرام/لتر) عقبة رئيسية حيث إنها تدفع بتنفيذ خطوة المعالجة الهوائية المكلفة.

على الهيئات المصرية أن تستلهم تجارب دول أخرى أكثر تقدمًا من حيث إدارة المياه ومياه الصرف الصحي في المنطقة مثل الأردن والمغرب. تطبق كلا البلدين معايير أكثر واقعية (250 ملليجرام/لتر قيمة قيمة الاكسجين الكيميائى الممتص في المغرب؛ 300 ملليجرام/لتر قيمة قيمة الاكسجين الكيميائى الممتص للمعالجة الحيوية في الأردن. وتتبع المغرب نهجًا تدريجيًا في تطبيق المعاير القياسية الخاصة بها. بالتاكيد مثل هذا النهج التدريجيي هو المنهج المناسب للتطبيق في المناطق الريفية في مصر.

Executive summary

KEY STATEMENTS

- Lack of baseline data and design parameters characterising rural wastewater in the Nile Delta is hindering the selection and design of cost-effective options for settlements under 5,000 inhabitants.
- This report references the scarce existing data and provides a first-hand data baseline, including a characterisation of sewage, septage and animal manure in ezbas. Factors and practices influencing wastewater quantities and characteristics are described, based on the visit of more than 40 villages and detailed studies in 8 selected villages completed by numerous interviews.
- Useful tools for field work are provided, such as semi-structured interview guidelines and a household survey guideline (all in English and Arabic – downloadable on www.sandec.ch/esriss).
- The costs currently born for drinking water and sanitation by the inhabitants of the ezbas under investigation are highly variable. The villagers with traditional bayaras have to pay a very high cost, sometimes 20 times more than those served by governmental sewer systems. It shows a high inequality between served and unserved areas.
- Regarding the price of drinking water, the results show that, with an average between 0.7 and 1 EGP/m3, the villagers pay significantly more than the official tariff. Besides, the water bills are in general not directly linked to the actual consumption.
- In the five villages under investigation, the water consumption varies from 60 to 110 L/cap/day. People face serious problems with the water infrastructure. Even if most households are connected to the water supply network, most of them reported problems with drinking water, such as interruptions and low pressure.
- The high variability of the small settlements should be taken in to account. Thorough case-by-case preliminary assessment are necessary to determine the design parameters and most cost-effective options. Reliable statistics regarding critical factors such as the population number and the water consumption are lacking at that scale. Important decision factors are the density and shape of settlements, proximity to drains or canals, groundwater table, quality of the water supply or number of animals per household, which impact on the cost and selection of options.
- The skills, capacities and willingness to participate differ from one village to the other. The key stakeholders should be involved in the process from the start. It is highly recommended that the management scheme be discussed and validated before the final selection of technical options.
- The lack of flow measurement is observed as a major shortcoming.
- A cost-effective way to reduce contamination loads in water bodies would be to build proper septage disposal points, in the form of a primary treatment unit. The private service providers could pay a small fee for each discharge, which would cover the small O&M costs.
- The provision of technical support to the communities willing to pay for a sewer system should be further extended.
- The law 48/1982 should be revised as a prerequisite for sound rural wastewater treatment and investment. The stringent regulations “kill” simple but robust solutions and induce complex and costly options that do not work on the long term. The main limiting factor is the COD value (80 mg/L), which is even significantly lower than the standard in the European Union (125 mg/L).
- Inspiration can be taken from countries such as Jordan and Morocco, which have much more pragmatic standards (250 mg/L COD in Morocco; 300 mg/L COD for biological treatment in Jordan). Morocco is implementing its standards with an incremental approach.

This report is a result of the *Egyptian-Swiss Research on Innovations in Sustainable Sanitation* (ESRISS - www.sandec.ch/esriss), a parallel research component of the World-Bank funded *Integrated Sanitation and Sewerage Infrastructure Project* (ISSIP); this component is administered by the *Swiss Federal Institute of Aquatic Science and Technology* (Eawag) in partnership with the *Egyptian Holding Company for Water and Wastewater* (HCWW) and financed by the *Swiss State Secretariat for Economic Affair*s (Seco).

This report is primarily addressed to all stakeholders of the sanitation sector, decision-makers, governmental agencies, consultants and academics, who deal with rural sanitation and small-scale sanitation in general. It completes the first report of the ESRISS Project, "*Small-Scale Sanitation in Egypt: Challenges and Ways Forward*" , as well as the 10 Points Research for Policy Brief, and lay the basis for the further report "*Small-Scale Sanitation in the Nile Delta: Material Flow Analysis*". All documents can be downloaded from ESRISS webpage (www.sandec.ch/esriss).

Objectives

Lack of baseline data and design parameters characterising rural wastewater in the Nile delta is seen as a major gap in the development of sound sanitation strategies for settlements under 5,000 inhabitants. Such data is usually made up of the characteristics and quantities of the wastewater to treat, be it in the form of sewage or septage. However, Nile delta ezbas and villages are very heterogeneous, which prevents the definition of values applicable to all settlements; instead, developing a baseline data in this context means understanding current sanitation practices, the factors influencing the quantities and characteristics, and the extent of this influence.

The ESRISS project decided to put together a first baseline data, with the following objectives:

1. Gather all the information available and reference them in one report
2. Complete the data set with own analyses of sewage, septage and animal manure samples
3. Describe the current sanitation practices in Nile delta villages, incl. household-level behaviours and bayara emptying activity
4. Understand the factors influencing wastewater quantities and characteristics
5. Describe the existing water and nutrient reuse practices
6. Quantify the sanitation-related financial flows in the current scenario

The analysis and modelling of the sanitation-related flows is to be found in the *Material Flow Analysis* report.

Methodology

The following activities were carried out to achieve the objectives of the study:

- Literature review of the documents about rural sanitation in Egypt
- Selection of villages suitable for conducting the baseline study
- Semi-structured interviews with the sanitation key stakeholders: (i) village authorities (omda, sheikh al balad); (ii) bayara emptiers; (iii) farmers; (iv) sewer operators; (v) owners of non-residential buildings.
- Household surveys
- Field observation, transect walks
- Sampling campaigns, partly with own portable lab equipment

The visited villages are all located in the two command areas defined by ISSIP (Mahmudeya and Mit Yazid), over three Governorates (Beheira, Gharbeya and Kafr El Sheikh), and the villages studied are all in Beheira Governorate. The field work was carried out in partnership with HCWW and the respective Affiliated Companies, with support from the ISSIP PM/TA.

Results & Recommendations

The scarce existing information is referenced in one single report and a first baseline data is established, including a detailed characterisation of sewage, septage and animal manure in ezbas. Factors and practices influencing wastewater quantities and characteristics are described, based on the visit of more than 40 villages and detailed studies in 8 selected villages completed by numerous interviews with sanitation stakeholders and field observation. Field work included: (i) 168 household surveys; (ii) 5 interviews with bayara emptiers; (iii) 14 interviews with farmers; (iv) 3 interviews with persons responsible for sewer maintenance; (v) 3 interviews with persons responsible for non-domestic buildings. This work leads to a clear picture of the current practices, highlighting the high diversity of village features in the Nile delta, and defines precisely the situation in the 8 villages under investigation. This assessment of the existing situation is available as a basis for future sanitation projects; part of it already contributed to Batch 1 of the ISSIP's decentralised component. In order to get a full data baseline for rural sanitation in the whole country, it is recommended to replicate the field studies in Upper Egypt, where the situation is different. This would lay a strong basis for the development of national policies and guidelines.

Useful tools for field work have been developed, such as semi-structured interview guidelines, a household survey guideline (all in English and Arabic) and a protocol for sample analyses with a portable lab. Altogether, they form a tool package for the preliminary assessment of small settlements.

Wastewater characteristics and quantities

The sampling campaigns have shown the high variability of wastewater quantities and characteristics at that scale. Rural wastewater is clearly more concentrated than urban wastewater, which should be taken into account for future designs. Regarding septage from the bayaras, it is five to ten times more concentrated than the average sewage from such villages.

The analysis of the current practices highlights the factors causing this high variability. The villagers who rely on on-site sanitation systems tend to minimise their water consumption in order to reduce the emptying frequency. The surveys have shown that approximately half of the greywater produced by bayara owners is discharged directly in the environment and thus do not contribute to dilute septage. For this reason, wastewater production increases very significantly when a sewer network is built; this increase may only be restrained in some villages by inadequate water supply (low pressure and interruptions).

The baseline data would greatly benefit from further sewage and septage sample analyses in ezbas. Further sampling campaigns should be organised, in more villages, but also on a more extensive period of time. Understanding of seasonal variations, as well as daily variations and peaks should be strengthened by more data.

In general, flow measurements is observed to be a major shortcoming in Egypt, and any new wastewater infrastructure would greatly benefit from close inflow monitoring; this in turn would help to better design further treatment plants. Any project should be systematically documented and monitored, in order to generate lessons learnt and reliable data; this is currently hardly the case.

Importance of case-by-case assessments

This study reveals the high heterogeneity of the small settlements in the Nile delta. These differences in density, shape, proximity to drains or canals, groundwater table, quality of the water supply, number of animals per household have an impact on how the sanitation system should be designed and which options are more cost-effective. In particular, these factors have a strong influence on the quantities and characteristics of the wastewater to be treated and on the cost of the sewer system per capita. Thus, it is recommended to have a case-by-case approach for planning and selection of appropriate technologies. For any new project, a site-specific preliminary assessment is necessary (see also the report "*Challenges and Ways Forward*" and the report "*Material Flow Analysis*" which details the parameters to be collected on a site-specific basis).

The key village sanitation stakeholders should be involved in the process from the start. It is highly recommended that the future management scheme be discussed and validated before the final selection of technical options. A major failure factor is the construction of infrastructure without knowing who will maintain and operate, who will pay, which skills are needed and who will provide training. Work with the community and local sanitation stakeholders is overly important for sanitation in small rural settlements.

Our study shows that there are no reliable statistics and no reliable numbers regarding critical factors such as the population number, the water consumption and the number of animals. Even the population number provided by the census often significantly differ from the reality. A thorough preliminary assessment provides context-specific design parameters, which are a key cost-effectiveness factor as they allow dimensioning as close as possible to the needs. Animal manure and effluent of dairy factories need to be considered as parts of the sanitation system. Wastewater, animal manure and stormwater are closely linked in such settlements and should be dealt with together. In many villages, solid waste should also be managed in parallel.

In the past, faulty dimensioning of infrastructure due to the lack of consideration of the actual situation on the ground cost a significant amount of money, in capital and operational costs, and threatened the replication of small-scale systems. Besides, treatment facilities that are over-dimensioned risk reaching the full life expectancy far before they reach their design capacity; over-dimensioning may also lead to reduced performance. The development of ezbas is highly heterogeneous and depends on a number of factors that are difficult to forecast, leading to large variations in population growth. Modular, flexible systems need to be privileged in order to cope with the high uncertainty of future developments.

Water consumption

Only water meter readings over a period of at least one week (including at least two readings per meter) can provide a realistic estimation of the water consumption. It cannot be based on the price paid by the household for water, as the water bills are very often not directly linked to the building consumption.

In the five villages under investigation, the water consumption varies from 60 to 110 L/cap/day. Two main factors explain this variability: (i) the households with on-site sanitation system tend to reduce their water consumption in order to minimize the filling of the bayara; (ii) the quality of the water supply system (interruption and pressure). People in the villages face serious problems with the water infrastructure. Even if most households are connected to the water supply network, most of them reported problems with drinking water, such as interruptions and low pressure. In three villages (Ashara, K. Nuss and Hadery), 60-95% of the household members interviewed suffer from frequent and long lasting interruptions. Also, in these villages, 70-100% of households face problems with water pressure. Most households are equipped with a pump which is sometimes even necessary for the ground floor. In Kabeel and Hamamee the situation is better with around 50% of the inhabitants complaining about the pressure and interruption. In Manshet Nassar, which is located close to a drinking water plant, the situation is much better. In every village, some households (25 to 70%) import water from other sources than the household tap, such as wells or canals (for washing purposes). Many people are doing the laundry and/or the dishwashing outdoor and discharge the water on the street or in a water body nearby (drain/canal).

Costs of sanitation

This study shows that the costs currently born by the inhabitants of the villages under investigation for drinking water and sanitation are highly variable. It highlights the very high costs that the villagers relying on traditional bayaras have to pay, sometimes 20 times more than those served by governmental sewer systems. On the contrary, the amount paid for wastewater services from the water bills is insignificant. It shows a high inequality between served and unserved areas.

Regarding the price of drinking water, the results show that, with an average between 0.7 and 1 EGP/m3, the villagers pay significantly more than the official tariff. It also shows that, in general, the water bills are not directly linked to the building consumption. It is recommended to cross-check regularly water readings from a few water meters with the respective water bills and what is finally counted at the level of the Affiliated Company. On the positive side, it shows that people are actually ready to pay more than the official tariff.

Emptying of the bayaras is a significant burden for the household budget in villages served by such on-site facilities. One trip of a privately owned emptying truck costs on average 25 EGP. Public trucks are generally cheaper, but they are rare and they mostly stay in the mother-village. The business is thus dominated by private service providers. The frequency of emptying is high (on average, every 10-30 days). On a village average, the truck makes 2-3 trips per bayara. It results in high costs, between 7 and 28 EGP/cap/month in average for the villages under investigation.

In such a situation, many communities decided to build their own “informal” sewer network. The costs amount on average to about 530 EGP/household for the main lines and 550 EGP/household for the installation of the household. The data show that the investment is offset only in a few months to about three years, depending on the village situation. If villagers would build proper shallow sewer systems, the price would certainly be higher. However, on the medium term, in most cases, it would still certainly be more cost-effective than keeping the bayaras. Case-by-case financial comparisons should be made in order to encourage villagers to invest. If the investment costs are too high to be paid at once, leasing mechanisms could be thought of, with monthly payments that are inferior with the amount currently paid for bayara emptying.

Reuse practices

In terms of water and nutrient reuse, this study shows the awareness of Egyptian farmers about the benefits of nutrient recovery and the economic value of manure and sludge. Animal manure and dry sludge are widely used, and sometimes bought. So far, they are used complementarily to chemical fertilisers, which are subsidised by the government. Wastewater reuse for aquaculture has also been observed. The main constraint for nutrient and treated wastewater reuse is transport and storage, especially for liquid manure.

There is a strong interest in organic fertilisers: sludge, manure and compost. It highlights a need of the Egyptian farmers. The selection of sanitation systems should be geared towards the production of good quality fertiliser material and the conservation of nutrients. Small scale systems are particularly fit to this aim, as the sludge in small settlements is not contaminated by industrial activities and the product can be reused on-site by the villagers themselves. It is thus important to produce a well stabilised sludge and foster the production of good quality compost at farm level.

Both in villages with on-site sanitation and with sewers, the proportion of discharge of liquid manure into the sanitation system is around 25% (0-50%, based on investigations in 6 villages). In a village with a person responsible for the sewer maintenance this amount is lower because of the establishment of a rule forbidding such discharge (about 9% in Kawm al Nuss, Beheira). Most farmers collect the liquid manure separately, but mostly do not use it because of transportation constraints. It is recommended to organise a collection service at village level; liquid manure could be mixed with organic waste in a compost trench or stored in a tank to enable mechanical transport to the fields at the appropriate time. Such a service could be coupled with solid waste collection and/or maintenance of the sewer system(s). This would lead to the establishment of integrated environmental service providers. Solid waste collection services and sewer maintenance services already exists in numerous villages.

If possible, the treated effluent should be reused directly for irrigation, without transiting through a contaminated drain. The construction of a small pond as a polishing step, from which farmers can directly pump, is recommended. Where aquaculture ponds exist, they should be used as a final polishing step.

Septage management

Septage management and the bayara emptying business are better understood, which provides a basis for inclusion of this sector in future sanitation schemes. The interviews and surveys give an insight about the costs currently carried by the population for sanitation. It shows also which efforts the local communities deploy to solve the most urgent sanitation problems, such as high costs of bayara emptying, overflow, soil saturation and capillarity rise in buildings.

The emptying of bayaras is done mechanically by trucks, which transport and discharge the septage in the nearest drain. Although Village Councils usually own one truck, the majority of them are privately owned. Bayara emptying is thus mainly an informal private business, which seems to be a rather good business.

A cost-effective way to reduce contamination loads in water bodies would be to build proper septage disposal points, including a primary treatment unit. The private service providers could pay a small fee for each discharge, which would cover the small O&M costs.

This study provides average septage characteristics. The results from the sampling campaigns are very heterogeneous, as septage characteristics are influencing by various factors, especially (i) the way of emptying; (ii) the residence time in the bayara; (iii) the interaction with groundwater. The total amount of septage produced is still not clear because of the difficulty to measure the infiltration/exfiltration in the bayaras. Next to that, the private service providers hardly keep any record, so that it is difficult to estimate the number of trips at village level per month. Further monitoring is needed in order to provide proper design parameters at village level.

Private initiatives

This study reveals how citizens and communities independently developed strategies to cope with the situation in the most cost-effective way. For those relying on bayaras, they make their most to reduce the emptying frequency (e.g. addition of salt to increase infiltration, discharge of the greywater in the streets). However, many communities decided to gather the amount of money to construct a basic “informal” sewer system in order to eliminate the burden of the bayaras (high emptying frequency, high costs, limitation of water consumption). Unfortunately, the lack of technical expertise often turned this constructive initiative into the source of further problems.

It is recommended to take advantage of these private initiatives to support and improve them. The decision taken in 2012 by HCWW under the auspices of HE Minister Abdel Kawi Khalifa to provide technical support to the communities willing to pay for a sewer system should be further extended. Where people still rely on on-site sanitation systems, the Government can build upon the well-developed private bayara emptying business in order to improve the existing practices and provide proper disposal points.

Construction of household biogas digesters fed by animal manure and blackwater where cattle and space is available, such as in Upper Egypt and in the northern delta, is a promising alternative. The experience shows that many households are ready to invest several thousand EGP into it.

Adaptation of laws and regulations

The law 48/1982 should be revised as a prerequisite for sound rural wastewater treatment and investment. The stringent regulations “kill” simple but robust solutions and induce complex and costly options that do not work on the long term (O&M, recurrent investment costs, energy, availability of the necessary skills). The main limiting factor in this law is the COD value (80 mg/L), which is even significantly lower than the standard in the European Union (125 mg/L), as shown in Appendix 19. The dissolved oxygen level (> 4 mg/L) is also a major limiting factor, as it forces the implementation of a costly aerobic treatment step.

The Egyptian authorities should inspire themselves from the countries in the region which are more advanced in terms of water and wastewater management, such as Jordan and Morocco. Both countries have much more pragmatic standards (250 mg/L COD in Morocco; 300 mg/L COD for biological treatment in Jordan). Morocco is implementing an incremental approach for the implementation of the standards. Such an incremental approach is certainly the way to go for the rural areas in Egypt.

Acronyms

BOD_5	Biological Oxygen Demand
BWADC	Beheira Water and Drainage Company
COD	Chemical Oxygen demand
Cond.	Conductivity
DO	Dissolved oxygen
EAWAG	Swiss Federal Institute of Aquatic Science & Technology
EGP = LE	Egyptian Pound = “Livre Egyptienne” (1 EGP = 0.15 CHF - *rate on 22.01.2012*)
ESDF	Egyptian-Swiss Development Fund
ESRISS	Egyptian-Swiss Research on Innovations in Sustainable Sanitation
HCWW	Holding Company for Water and Wastewater
ISSIP	Integrated Sanitation & Sewerage Infrastructure Project
LE = EGP	Egyptian Pound
MFA	Material Flow Analysis
NH_4-N	Ammonium
NO_2-N	Nitrite
NO_3-N	Nitrate
NRC	National Research Centre
PM/TA	Project Monitoring / Technical Assistance
PO_4-P	Orthophosphate
SANDEC	Department for Sanitation in Developing Countries (Eawag)
SD	Standard Deviation
SECO	Swiss State Secretariat for Economic Affairs
TDS	Total dissolved solids
TN	Total nitrogen
TP	Total phosphorus
TS	Total Solids
TSS	Total suspended solids
TVS	Total volatile solids
VSS	Volatile suspended solids
WUA	Water User’s Association
WWTP	Wastewater Treatment Plant

Small-Scale Sanitation in the Nile Delta

Baseline Data and Current Practices

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It is the second published of a series of reports and is the basis for the Material Flow Analysis report.

Before that, the ESRISS Project published a report entitled "Small-Scale Sanitation in Egypt: Challenges and Ways Forward", which was then synthesised in a Research for Policy Brief, entitled "Small-Scale Sanitation in Egypt: 10 Points to Move Forward".

1 Introduction

Lack of baseline data and design parameters characterising rural wastewater in the Nile delta is seen as a major gap in the development of sound sanitation strategies for settlements under 5,000 inhabitants (Reymond et al, 2012). Such data is usually made up of the characteristics and quantities of the wastewater to be treated, be it in the form of sewage or septage. However, Nile delta ezbas and villages are very heterogeneous, which prevents the definition of values applicable to all settlements; instead, developing a baseline data in this context means understanding current sanitation practices, the factors influencing the quantities and characteristics, and the extent of this influence.

The ESRISS project decided to put together a first data baseline, with the following objectives:

1. Gather all the information available and reference it in one report
2. Complete the data set with own analyses of sewage, septage and animal manure samples
3. Describe the current sanitation practices in Nile delta villages, incl. household-level behaviours and bayara emptying activity
4. Understand the factors influencing wastewater quantities and characteristics
5. Describe the existing water and nutrient reuse practices
6. Quantify the sanitation-related financial flows in the current scenario

The following methodology was used to achieve the objectives of the study:

- Literature review of the documents about rural sanitation in Egypt
- Selection of villages suitable for conducting the baseline study
- Semi-structured interviews with the sanitation key stakeholders: (i) village authorities and representatives (omdas, sheikhs al balad); (ii) bayara emptiers; (iii) farmers; (iv) sewer operators; (v) owners of non-residential buildings.
- Household surveys
- Field observation, transect walks
- Sampling campaigns, and analyses partly done with own portable lab equipment

The visited villages are all located in the two command areas defined by ISSIP (Mahmoudiya and Mit Yazid), over three Governorates (Beheira, Gharbeya and Kafr El Sheikh). The field work was carried out in partnership with HCWW and the respective Affiliated Companies, with support from the ISSIP PM/TA.

This report is primarily addressed to all stakeholders of the sanitation sector, decision-makers, governmental agencies, consultants and academics, who deal with rural sanitation and small-scale sanitation in general. It completes the first reports of the ESRISS Project, “ *Small-Scale Sanitation in Egypt: Challenges and Ways Forward*”, as well as the 10 Points Research for Policy Brief. All documents can be downloaded on ESRISS webpage (www.sandec.ch/esriss). The analysis and modelling of the sanitation-related flows is to be found in the report “*Small-Scale Sanitation in the Nile Delta: Material Flow Analysis*”.

2 Methodology

2.1 Literature review

A thorough literature review was carried out in order to identify the existing documents dealing with the sanitation situation and practices in rural Egypt and featuring data on rural wastewater characteristics; the review led to the identification of the gaps in knowledge.

Existing documents should always be taken with caution and the reliability of data assessed. Data quality (especially statistics) is often questionable, and, in very dynamic contexts, may be quickly outdated. It should be kept in mind that many reports, especially from consultants, are never published officially and cannot be found on Internet. Individual meetings with the various organizations and agencies have been carried out. Part of the literature review was conducted in the library of Chemonics Egypt, where there is documentation on the numerous projects Chemonics has been involved in as well as other studies collected during the last 20 years.

2.2 Village / ezba selection

Field work was carried out in three phases: November 2011 - February 2012, March - May 2013 and March - May 2014. Each of them focused on a different village selection. The selection procedure as well as the selected villages are described below.

2.2.1 Governorate selection

Beheira Governorate was selected among the three Governorates of ISSIP (Beheira, Garbeya, Kafr El Sheikh), as the Affiliated Company in Damanhur (Beheira Water and Drainage Company – BWADC) offered good working conditions, such as:

- An English-speaking *Department for International Cooperation*, facilitating the execution of projects, making the interface with the other departments of the Company and facilitating logistics.

- The company is the most advanced of the three related to ISSIP, especially regarding data collection, master planning and GIS database.
- The Company has its own guesthouse.

2.2.2 Selection criteria for villages

Villages suitable for further study were selected based on the following criteria:

I. Population between 500 and 5’000 inhabitants (ideally between 1’000-3’000)
II. Domestic wastewater only (no presence of industry)
III. Acceptance and support from the local authorities (*Omdas* or *Sheikhs al Balad*)

Care was taken that the diversity of Egyptian villages was well represented in the selection, e.g. bayara-based villages vs. villages served with an informal sewer network, compact village vs. long villages along canals, high- vs. low-density villages.

2.2.3 Identification methods

There are more than 6’000 satellite villages and ezbas in Beheira Governorate. The administrative hierarchy and the respective number of units in Beheira are presented in Table 1. Each village together with several hamlets (also called *ezbas*) form an *omodeya,* led by an *omda*, assigned by the government. *Sheikhs al Balad* are responsible for one settlement only and can be found in almost every village, satellite or hamlet. *Sheikhs al Balad* are informal leaders of the respective communities.

Table 1 Different administrative level (Source: El Beheira Governorate Statistics 2006)

Administrative division	Markaz	Main (mother) village *(Markaz el Qaria)*	Satellite village *(Omodeyat)*	Hamlets
Local authority	City council	Village Council	*Omda*	*(Sheikh el balad)*
No of respective units in Beheira	15	84	497	5’737

In order to sort out these settlements and get to a final selection, the BWADC and three different administrative levels were visited, from the highest level to the lowest: Markaz (City Council), Mother Village (Village Council, composed of representatives of the Mother Village and all depending satellites) and the satellite villages/hamlets themselves. During the second field campaign, the selection of villages was based on ISSIP preselection (Hydroplan 2013).

The starting point for the identification of villages in the first phase was BWADC. Next to the above mentioned criteria, the following characteristics were sought, in order to reduce the number of potential candidates:

- Expressed demand for a sanitation system

- Existing project related to sanitation (e.g. solid waste management); this would show a certain level of environmental awareness
- Some form of organization within the community, e.g. an active Community Development Association (CDA) or Water Users' Association (WUA)

Two different administrative levels were visited as entry points: the city councils at *markaz* level and the village councils in the mother villages.

Village councils proved to be the most suitable source for the information needed, as they are directly dealing with the smaller settlements. They are aware of all the villages in their area of authority, the problems they are facing, the existence of SWM projects, organizations like CDAs and special initiatives. In addition, the village councils can provide facilitators for field visits. It proved to be an important advantage as villagers know this person and thus it is easier for them to trust the visiting mission and talk openly.

The small number of villages under the authority of the Village Councils is their main advantage as "entry points" but also the main drawback: the number of village councils in an area such that of ISSIP is high and careful pre-selection has to be made. This pre-selection was done via satellite images. More information was expected in the city councils, as they are directly responsible for their respective districts; however, they only claimed responsibility for the city they are based in.

BWADC could only provide limited information for the scale under study. There are experienced engineers in BWADC that are informed of the situation in different villages and can provide satellite images and data from the census; however, the information required for our scale is not centralised, so that we could only count on the personal knowledge of our talking partners. Besides, BWADC has been working in the sanitation sector only since a few, as it was previously responsible for the drinking water supply only.

In the first campaign, 22 villages were visited (APPENDIX: **The appendices can be downloaded at www.sandec.ch/esriss, in case they are not attached in the report in your possession.**

Appendix 1), out of which six were considered as potential candidates.

For the second field campaign the villages were chosen from the list preselected by ISSIP PMTA for Batch2 implementation of small-scale systems (Hydroplan 2013). Nine potential candidate villages were considered.

For the third campaign, 13 villages were selected based on satellite images. The selection criteria were: i) isolated villages with ii) a size from 1000 to 3000 inhabitants and iii) relying on "informal" sewer network(s).

2.2.4 Final selection of villages

A second round of visits was organised in the preselected villages for a deeper assessment in order to select the three most interesting ones. In this round, focus was on the specific characteristics of each village, as well as testing the willingness-to-collaborate of the village head (*omda* or *sheikh al balad*). The idea was to select during each campaign three different types of villages, out of which at least one is unsewered and one has informal sewers.

The goals of this second round of visits were:

- The final selection of villages, based on the selection criteria
- A preliminary description of villages
- The identification of "community champions" (active members of the community), establishment of personal contacts in the village and securing collaboration with local authorities (e.g. *omda*)

Activities carried out during the visits included:

- Meeting with the *omda, sheikh al balad or other village leader*: description of the planned activities (surveys and sampling), trust building, establishment of a good relationship and securing collaboration and support; preliminary interview (see semi-structured interview guideline in Appendix 6)
- Transect walk in the village, accompanied by the *omda* and/or one of his representatives. Gaining the trust of the inhabitants and preliminary mapping of sanitation-related information
- Understand the current sanitation system (sources, ways, disposal), get an idea on where sampling could be made.

2.3 Semi-structured interviews and surveys

In order to get first-hand information, semi-structured interviews and surveys were carried out with the key-stakeholders: omdas, households, farmers, bayara emptiers, people working for the maintenance of sewers and people working at local health centres. The household survey and interview guidelines to other key stakeholders are available in Appendix 7 to Appendix 12. For the second campaign the questionnaires were shortened in order to get the information needed for the MFA more quickly. The short version of the household survey can be found in Appendix 8.

The objectives of these surveys were:

- Collection of data to quantify and characterise the flows relevant for the MFA model:
  - Water consumption
  - Volume of wastewater produced by the community (greywater/blackwater) and fraction ending up into the sanitation system (sewers or bayaras)
  - Volume of septage / faecal sludge emptied from the bayaras

    - Volume of manure (liquid and/or solid) ending up into the sanitation system

- Understand behaviours that affect the volume and quality of wastewater to be treated (handling of manure, separate collection and disposal of greywater…)
- Collect basic financial data to perform cost analysis of the current situation
- Investigate people's views on what the weak points of the current system are and their attitudes towards different stakeholders
- Investigate the farmers' views towards reuse of wastewater and sludge

2.3.1 Household surveys

At a first stage, the *omda* or *sheikh* was asked to identify and propose a set of households for the surveys to be held. These households should present variations in the main occupation, level of income and social status. Later, when villagers were more familiar with the procedure and the members of the study team, selection of buildings was random, making sure that buildings are located in different parts of the village.

The questionnaire (Appendix 7 and its short version Appendix 8) consists of six sections, covering the different topics of relevance, namely:

A. Household characteristics: size of household, main occupation, type of toilet and sanitation system

B. Drinking water supply: quality of water supply, quantity of water consumed, alternative sources of water, monthly bills and level of satisfaction with BWADC

C. Greywater: sources and amount of water for washing, collection of greywater and disposal; products used for cleaning/washing/personal hygiene

D. Blackwater: (i) Sewers (type of sewers, problems related with them and maintenance, expenses related with them); (ii) On-site sanitation (design and dimensions of bayara, frequency and ways of emptying, disposal of sludge, problems and expenses related with them)

E. Animal Manure: species and number of animals, quantities and handling of solid and liquid manure, reuse practices

F. Organisational and institutional aspects: organisation of the community, services offered, views towards CDA and NGOs (if any), Village Council, BWADC

Though the questionnaire is quite lengthy and highly structured, there is space for any information the interviewee wish to bring up and they were encouraged to do so.

Before preparing a survey, it is important to know exactly which data is needed and what it will be used for. The following points are important to be kept in mind (adapted from (Tayler-Powell 1998)):

- Purpose of data to be collected, expected use (e.g. frequency, percentage)
- Information available elsewhere?
- Keep only necessary questions, so as not to overburden the surveyed persons, except a few contact questions at the beginning to put the interviewee at ease
- Try to view the questions through the respondent's eyes; wording is important; understand and utilize the social language, the specific vocabulary and be aware of context-sensitiveness[1]
- The response or information obtained is only as good as the question!

2.3.2 Semi-structured interviews for key sanitation stakeholders

Semi-structured interviews are a way to structure discussions aimed at collecting information. Semi-structured interviews can be led with individuals or in focus groups. They require time and experienced interviewers, but help to build a solid basis for further work.

Semi-structured interviews are conducted with a fairly open framework which allow for focused, two-way communication (adapted from (FAO 1990)). They can be used both to give and to receive information. Not all questions are designed and phrased ahead of time, hence the “semi-structured” essence. The majority of questions are created during the interview, allowing both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues. This freedom helps interviewers to tailor their questions to the interview context/situation, and to the people they are interviewing. Often the information obtained from semi-structured interviews will provide not just answers, but the reasons for the answers.

Topics addressed in the questionnaire for the drivers or owners of emptying trucks (questionnaire in Appendix 9) are the quantities of sludge from on-site systems, problems related with them, disposal sites, as well as financial and organisational aspects of the business.

The questionnaire for workers responsible for sewer network maintenance (questionnaire in Appendix 10) include questions on the type of sewer network (depth, diameter, material), the problems related to it and needs for maintenance, disposal of sewage and financial aspects.

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[1] For example, a question like “Do you discharge sludge directly on agricultural fields?” may threaten a truck operator, which is usually aware of the non-conformity – or even illegality - of such practice; he may then answer “no”, even if he does. Thus, the question should rather be formulated as: “Some farmers are known to ask for sludge on their fields. Did they ever contacted you, and how?”

The questionnaire for farmers is shorter (questionnaires in Appendix 11). Topics covered are use of fertilisers and manure (types, quantities, prices), handling of manure and attitudes towards use of raw sludge, treated wastewater and treated sludge on the fields.

The questionnaire for persons responsible of non-residential buildings include questions about the sanitation system, the amount of septage/sewage and about the water consumption (questionnaire in Appendix 12).

2.4 Transect walks, field observations

The transect walks have two main objectives:

a) Mapping the relevant sanitation-related features:

  - Geographical characteristics (canals and drains, topography)
  - Housing conditions (density, number of floors, type of stable)
  - “Hot spots” where problems occur, such as high groundwater, overflowing of sewers/bayaras, smells, quality of water in the drains
  - Typology of sanitation systems (e.g. sewered and unsewered households, characteristics of on-site system, sealed or non-sealed bayaras)
  - Identification of special features

b) Understanding the existing sanitation systems (sources, storage, collection, transport, disposal):

  - Sources: households, different types of buildings (schools, mosques…), practices regarding laundry and dishwashing, manure handling
  - Collection and transport: (i) in case of a sewer system, observe the network, e.g. through manholes/ intermediate chambers, to get an idea on the depth, diameter, material, degree of functioning; (ii) in case of bayaras, get an idea of their size, accessibility, material of the walls if possible, and get in contact with bayara emptiers
  - Disposal: Identify disposal points of sewer networks and emptying trucks. Observe different practices for discharging greywater (e.g. on the streets) and the liquid part of manure

In addition the transect walk serves to get an idea on where sampling could be made. It also serves to gain the trust of inhabitants and familiarise them with our presence in the village.

Discussion and trust building with village representatives (right) and ride with a bayara emptier (below)

2.5 Mapping

The maps of the study area were obtained at Chemonics (for ISSIP1-Phase I) and Hydroplan (ISSIP1 - Phase II). GIS maps of the villages were obtained at the GIS department of BWADC.

Satellite images were available on Google Earth, allowing the creation of simplified detailed map of the current situation in the villages, including the sewer networks, outlets, drains/canals or hills, as shown in Figure 1.

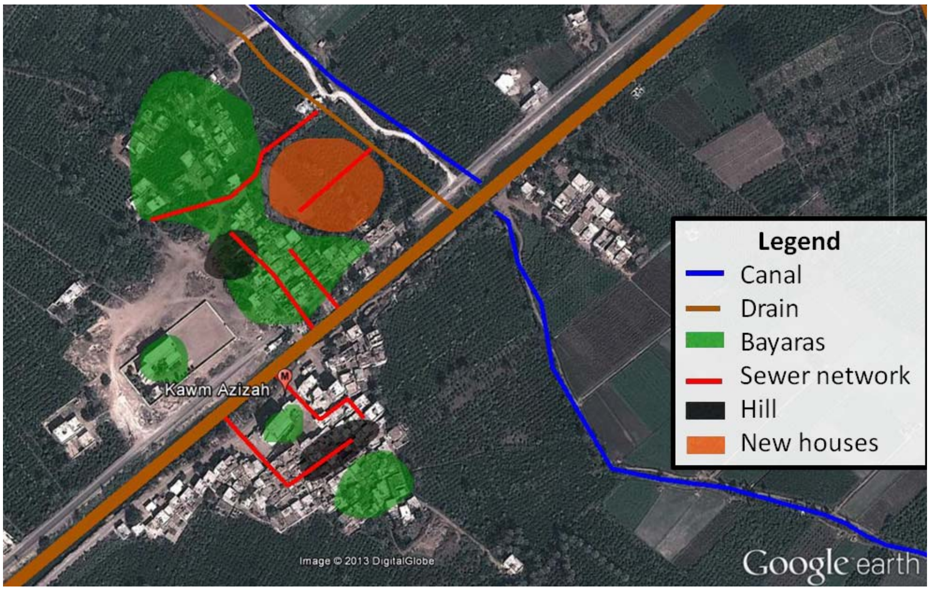

Figure 1 Example of map created for preselected villages - Kawm Azizah

2.6 Sampling campaign

Three sampling campaigns were designed and carried out for the characterisation of sewage, septage and liquid manure. During the first sampling campaign, in February 2012, all the samples were transferred from the sampling locations to Cairo to be analysed by the National Research Centre (NRC) the following day. During the second and third sampling campaigns, in May-June 2013 and 2014, the ESRISS project was equipped with a portable lab in order to be able to evaluate most of the parameters in Beheira.

The following parameters were always measured: BOD_5, COD, TS, TSS, NH_4-N, TN, TP, pH, DO and conductivity. During the two last campaigns, NO_3, NO_2 and PO_4 were also evaluated and BOD_5, TS and TSS were measured by the Central Wastewater Laboratory of Damanhur.

The procedure followed for the sampling and analysis of each flow is described below. All the samples, and composite samples, were kept in a cool box, in order to avoid alteration of the characteristics

With the team of the BWADC Wastewater Central

On-site analyses – El Hadery village, Beheira.

2.6.1 Sewage

Raw wastewater was collected directly from the outlet of the informal sewer networks or from a manhole as close as possible to it. In order to eliminate the effect of individual events, only composite samples were analysed. Two different sampling methods were used:

1. Morning sampling (08:00 - 13:00): either consisting of one composite sample made of twenty subsamples (50ml), taken every fifteen minutes, or consisting of three composites samples of 1.5 hour, each composed of 6 subsamples (200ml).
2. Full day sampling (24 hours): 16 composite samples (each composed of 6 subsamples of 200 ml) taken every 1.5 hour.

The first method permits to get an idea of the variation of the concentration at a same outlet in the morning, from one week to the other and among different outlets in the same village. The second method could be applied in two villages and allowed to estimate the daily variation of the wastewater characteristics and flow.

The flow could be measured in several sewer outlets. The most accurate results were obtained by measuring the time to fill a bucket of 18L. This action was repeated every 15 min. The flow was also measured through a self-constructed flow meter equipped with a weir and a pressure logger. The computation of the flow by this method is less precise, but still permits to observe the different peaks and has the advantage to provide measurements during several days. Details about the device used are available upon request.

Flow measurement with a self-constructed weir, equipped with a data logger

2.6.2 Septage

Septage samples were taken from the vacuum trucks at the disposal points. 500 ml of septage was collected at the beginning of the discharge, 500 ml when it was half empty and 500 ml shortly before the end; this method is tailored in order to make sure that the samples taken are representative of what would actually reach a treatment unit (Klingel 2001). The samples were subsequently mixed in a 1.5 L plastic bottle.

In order to be able to explain the difference in the results, truck drivers were also asked to provide information on the nature of the bayara characteristics: frequency of emptying, size of bayaras, number of trips, and numbers of people connected to the bayaras. If they were several trips for the same bayara, care was given to note the order of the trips, as the characteristics of each load may reflect the heterogeneity (layers) within the bayara.

Septage sampling

2.6.3 Liquid Animal Manure

Grab samples were taken from the holes collecting liquid manure in the stables. The content of the holes was gently stirred and a sample was taken with a plastic jar. The samples were transferred into plastic bottles. The sampling took place between 7:30 and 8:30 am, before the daily emptying of the collection holes.

Liquid animal manure sampling in a collection hole out of the stable

2.7 Laboratory analyses (2nd and 3rd campaigns)

In the first sampling campaign, the samples were analysed by NRC, with their own equipment and procedures. In what follows, we focus on the methods used during the second and third sampling campaigns, where the samples were analysed by ESRISS team itself and the Central Lab of BWADC.

Sample analyses with the portable equipment in BWADC guesthouse

2.7.1 Material and evaluation method

The second and third campaigns presents the advantage that 10 parameters were directly evaluated by the ESRISS team with its portable laboratory equipment. The devices used are:

- Spectrophotometer: DR2800 from HACH-LANGE
- Thermostat: LC200 from HACH-LANGE
- pH-meter: hQ40d from HACH-LANGE

The spectrophotometer, the thermostat and the pH-meter (©Hach Lange)

The 13 parameters were evaluated either with ready-to-use vials (LCK test), with powder pillows or by the Central Wastewater Laboratory of Damanhur as shown in Table 2.

Table 2 Method for the analysis of each parameter

	Abreviation	Executant	Test used
pH	pH	ESRISS	-
Dissolved oxygen	DO	ESRISS	-
Conductivity	Cond.	ESRISS	-
Biological oxygen demand	BOD_5	Central Lab	Manometric method
Chemical oxygen demand	COD	ESRISS	LCK514
Total solids	TS	Central Lab	-
Total suspended solids	TSS	Central Lab	-[2]
Nitrite	NO_2-N	ESRISS	Powder pillow, NitriVer3
Nitrate	NO_3-N	ESRISS	Powder pillow, Nitraver5
Ammonia	NH_4-N	ESRISS	LCK304
Total Nitrogen	TN	ESRISS	LCK138
Ortho-phosphate	PO_4-P	ESRISS	Powder pillow, phosVer3
Total phosphate	TP	ESRISS	LCK349

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[2] The Wastewater Central Lab of Damanhur used filters of 0.7µm.

Just after taking the samples, pH, DO and conductivity were measured with the portable probes; NH4, NO3 and PO4 were measured soon after the sampling in an improvised place near the sampling site, with the portable spectrometer. For the other parameters, the samples were kept in a coolbox and the measurements were done in the afternoon (or within 24 hours after the sampling took place). The detailed working procedure is given in Appendix 13 .

2.7.2 Precision analysis and error tracking

In order to monitor the quality of the analyses, the following tasks were carried out:

- Standard test for all parameters analysed (except TN and TP), computation of the correction factor for each test and rectification of the results
- Cross checking the result of the ESRISS team with the Damanhur lab and the NRC.
- Evaluating precision of the lab by giving them two same samples in a blind test

The precision of each result was computed based on:

1. The precision of a test, (given by the different steps described above)
2. Different measurements show that when a result was close to the range boundaries of the test, it was less accurate. An assumption of an uncertainty of 10% for result close to the range (<5%) was assumed.
3. The uncertainty related to lab manipulations (dilutions), which could be estimated by the precision of the graduated vial and the pipette

3 Literature review

3.1 Existing documents on the topic

Information on current sanitation practices in Nile Delta villages and quantities and characteristics of wastewater generated from them can be found in several Egyptian publications, mainly reports from relevant projects but also theses and scientific papers.

Three types of reports can be differentiated, with some reports falling in between:

a. Assessment of existing initiatives

b. Conceptual frameworks on how it should be

c. Global assessments of the Egyptian wastewater sector.

The present report can be seen as an update and complement to the assessment work done by Chemonics Egypt between 1991 and 2006 (Chemonics 1992; Gaber 2004; Chemonics 2006). It is worth going back to those reports, as they provide a very useful insight in success and failure factors of technical designs.

The *Basic Village Services (BVS)* and *Local Development II – Provincial Project* (LDII-P) projects, funded by USAID, which resulted in the implementation of 24 WWTPs in rural areas, has generated a wide array of publications. Reports from these projects, contain data on quantities and characteristics of rural sewage and septage, information on sanitation practices as well as methods developed during LDII-P for assessment of needs and project planning:

- *“Manual: Rural WW Project Planning”* (Chemonics 1991)
- *“GUIDELINES: Methodology and Terms of Reference to Conduct rural WS/WW Needs Assessments and Strategic Planning”* (Chemonics 1992)

More recent reports by Chemonics Egypt on rural sanitation include:

- *“Water Supply and Sanitation in rural Egypt – Assessment”* (Gaber and Bakr 1997)
- *“Stock-Taking of Egypt Rural Water Supply, Sanitation and Hygiene”* (Gaber 2004)
- “*Guidelines on Rural Sanitation - Draft Final Report*” (Chemonics 2006)

Relevant information is to be found in general studies about wastewater and sewage sludge reuse in Egypt:

- "*Wastewater Reuse in Egypt: Opportunities and Challenges.*” (Abdel Wahaab and Mohy El-Din 2011)
- “*Feasibility of Wastewater – Integrated Water Resource Management II – Report n°14.*”, published by USAID (IRG 2010)

- "*MEDA-Countries (Egypt, Lebanon, Morocco, Syria and Tunisia): Identification and Removal of Bottlenecks for extended Use of Wastewater for Irrigation or for other Purposes - Egypt Country Report.*" (AHT 2009)
- "*Sewage Sludge Management in Egypt: Current Status and Perspectives towards a Sustainable Agricultural Use*" (Ghazy, Dockhorn et al. 2009)

International cooperation agencies have also published a number of reports on assessments and lessons learnt:

- German cooperation (GIZ):
    - "*Decentralized Wastewater Management in Kafr El Sheikh Governorate, Egypt.*" (Wehrle, Burns et al. 2007)
    - "*Decentralized Wastewater Management in Kafr El Sheikh Governorate - Final Results and Lessons Learnt.*" (Jacoby 2012)
- Dutch cooperation:
    - "*Report on Wastewater Treatment Plants and Proposals for the Environmental Programme of FaWUOP.*" (Wickett 2007)
    - "*Identification of Sewerage Solutions for Small and Remote Villages - Draft Study to Assess the Social Feasibility of Community Owned Communal Sewerage Systems.*" (El Shorbagi 2008)
    - "*Drinking water supply and sanitation programme supported by the Netherlands in Fayoum Governorate, Arab Republic of Egypt, 1990-2009.*" (Netherlands 2011)
- Swiss cooperation:
    - "*Egyptian-Swiss Development Fund - Final Report 2009.*" (ESDF 2009)
- World Bank:
    - *"Assessment of Existing Sanitation Situation and Solid Waste Condition Report"* (Ahmed Abdel-Warith Consulting Engineers and ARCADIS Euroconsult 2007) for the *Integrated Sanitation & Sewerage Infrastructure Project* (ISSIP)
    - "*Estimating relative benefits of differing strategies for management of wastewater in Lower Egypt using quantitative microbial risk analysis (QMRA)*" (Evans and Iyer 2012)
- KfW:
    - *"Governorates of Sharkiya, Gharbeya, Damietta and Beheira. Improved Water and Wastewater Services Program"* (Technology Enterprises BCT 2007) for the *Improved Water and Wastewater Services Program* (IWSP)

A few PhD dissertations have been written on the topic:

- *"Policy Analysis and Development for Liquid Waste Management in Rural Egypt"* (Gemmell 1992)

- *"Comparative Study to Evaluate Different Technologies for Sewage Treatment in Rural Areas in Egypt"* (Ibrahim 1995)

Finally, there is a number of publications assessing the performance of different technologies where data on raw influent can be found:

- *"Sustainable technologies for domestic wastewater treatment in rural areas and small communities for appropriate agriculture use"* (Abdel Wahaab 2010)
- *"Evaluation of wastewater treatment technologies for rural Egypt"* (El-Gohary, Abou-Elela et al. 1998)
- *"Anaerobic Biodegradability and Treatment of Egyptian Domestic Sewage"* (Elmitwalli, Al-Sarawey et al. 2003)
- "*Evaluation of decentralized treatment of sewage employing Upflow Septic Tank/Baffled Reactor (USBR) in developing countries*" (Sabry 2010)
- *"Integrated waste management for rural development in Egypt"* (Shehata, El-Shimi et al. 2004)

3.2 Legal and regulatory framework

The delta is served by a network of canals and drains. Wastewater should be discharged in the drains, and it is illegal to discharge it in the canals. The canals are used to transfer water from the Nile for irrigation and potable water use. The drains are an extended network for collection and transport of agricultural drainage water and effluent from municipalities and industries. The drains ultimately flow either directly into the Mediterranean Sea or into irrigation canals and the River Nile, where drainage water is mixed with fresh water for further downstream use. Besides this official reuse of drainage water, unofficial reuse from drains is also carried out by individual farmers, when they are short of canal water (Gaber 2004; Wahaab and Omar 2011), which is illegal.

The law 48/1982, about the protection of the Nile and waterways from pollution, provides the standards that must be respected (parameters and values), as featured in Table 3. This law is criticised as being too strict to be realistic for the Egyptian context (requirement of secondary treatment for all discharges in Nile/ canals/ drains) (Gaber 2004). The main limiting factor in this law is the COD value (80 mg/L), which is even significantly lower than the standard in the European Union (125 mg/L), as shown in Appendix 19. The dissolved oxygen level (> 4 mg/L) is also a major limiting factor, as it forces the implementation of a costly aerobic treatment step.

In the Egyptian case, regulations counteract implementation in the rural areas. The stringent regulations "kill" simple but robust solutions and induce complex and costly options that do not work on the long term (O&M, recurrent investment costs, energy, availability of the necessary skills). Adaptation of this law is a prerequisite for sound rural wastewater treatment and investment.

The Egyptian authorities should inspire themselves from the countries in the region which are more advanced in terms of water and wastewater management, such as Jordan and Morocco. Both countries have much more pragmatic standards, as shown in

Table 4. Morocco is implementing an incremental approach for the implementation of the standards. The current standards were issued in 2006. They set values applicable for the period 2012-2016 (COD=600 mg/L and BOD=300 mg/L). From August 2016, WWTPs will have to comply with more stringent standards, which are however still far higher than those in Egypt: 250 mg/L COD and 120 mg/L BOD. Egypt should also aim at such an incremental approach for the rural areas.

Table 3: Discharge standards into non-potable water surfaces according to Law 48/1982

Parameters	Standards (mg/L, unless otherwise stated)
Temperature	Max. 35º c
pH	6-9
Biological Oxygen Demand (BOD)	60
Chemical Oxygen Demand (Dichromate)	80
Chemical Oxygen Demand (Permanganate)	40
Dissolved Oxygen	Not less than 4
Oils and Greases	10
Dissolved Solids (DS)	2000
Suspended Solids (SS)	50
Coloring Materials	Free of coloring materials
Sulphides	1
Cyanide	-
Phosphate	-
Nitrate	50
Fluorides	-
Phenol	-
Total of heavy metals	1
Probable counting of coliforms in 100 cm^3	5000

Table 4: International comparison of effluent discharge standards

Standards	Egypt	Morocco	Jordan	EU
COD (mg/L)	80	250	150 / 300*	125
BOD (mg/L)	60	120	60	25
TSS (mg/L)	50	150	60 / 120*	35

** For biological treatment plants or treatment plants with polishing ponds*

Fortunately, the decree 402/2009, issued by MWRI to decrease the legal concentrations of nitrogen and phosphorus in the WWTP effluent (thus implying tertiary treatment) has been withdrawn in autumn 2011, under the pressure of HCWW and a consortium of consultants and academics. This decree gave evidence to the lack of pragmatism in some institutions, and the lack of coordination prevailing.

The laws and decrees regulating the disposal and reuse of wastewater in Egypt, as well as the regulations contained in the Code for the Reuse of Treated Wastewater in Agriculture (501/2005), can be found in (Abdel Wahaab and Mohy El-Din 2011) and (IRG 2010). This code for reuse is under revision at the time of writing.

The sludge regulations were first set in the decrees 214/1997 and 254/2003, which were integrated in the Code for Reuse (ECP 501/2005); the standards are inspired by USEPA (for a comparison, the European standards are to be found in the EC Directive 86/278/EEC). It is prohibited to use sludge as an organic fertiliser outside the WWTP except after obtaining the approval of the competent administrative authority within the Ministry of Housing, the Ministry of Health and EEAA. The application of sludge should be within the following rates according to soil type: (i) 8-14 m^3/fd/y for clay soil; (ii) 10-16 m^3/fd/y for medium textured soil; (iii) 12-20 m^3/fd/y for light soil. However, these regulations are currently not enforced and sludge is reused by farmers with hardly any treatment.

Even if considered as a must by the Egyptian wastewater sector, chlorination of the effluent is not recommended at all. It is almost never done properly and results in environmental damage rather than preservation, in an environment where the quality of the receiving water body is often much worse than an non-chlorinated effluent. Chlorination of effluent prior to final disposal is a major technical problem for two reasons: (i) a shortage of chlorine makes it difficult for both water and wastewater plants to meet their supply needs; (ii) chlorine in effluent can be harmful to aquatic life in the discharge body (Chemonics 2006). It is recommended to apply a regulation such as in Switzerland, where the bacterial quality is set according to the quality and use of the receiving water body.

During the implementation of projects, NOPWASD stated that WWTP should be implemented at least 500 m. away from the settlements. This does not make sense for small-scale treatment units in the Nile delta. The real legal and regulatory basis of this statement should be further investigated and adapted.

Law 93/1962 about the discharge of liquid wastes states that any building within 30 m. of a public sewer line has to connect to it (Gaber 2004).

3.3 Quantities and characteristics of rural wastewater

3.3.1 Sewage

Several studies and reports provide a few values for raw wastewater characteristics in rural areas of Lower Egypt (Nile Delta and Fayoum). There is however only one recent project providing a significant amount of data, the decentralised sanitation project led by GIZ and RODECO in Kafr El Sheikh (Wehrle, Burns et al. 2007; Jacoby 2012); this data has not been published so far and is a courtesy from the GIZ-RODECO team.

Table 5 shows the results of sampling in three villages: El Moufty, El Kolea and Om Sen. It shows a big difference in TS, TDS and TSS among the villages; conclusions cannot however be drawn, as there are only one, resp. two samples from Om Sen and El Kolea. In general, we can observe a high variability of the characteristics, represented by the standard deviation (SD) of the results in El Moufty. Classification between summer and winter samples shows a high seasonal variability, with a raw wastewater which tends to be about twice more concentrated in winter in terms of organic matter and solids (Table 6).

Table 5: Synthesis of the data from GIZ-RODECO Kafr-El-Sheikh decentralised sanitation project

SEWAGE SAMPLES	**unit**	**El Moufty *(21 samples)***			**El Kolea *(2 samples)***		**Om Sen *(1 sample)***
Parameter		**AVERAGE**	**SD**	**MAX**	**AVERAGE**	**SD**	
Temperature	°C	**21**	*5*	30	**27**	*2*	**18.8**
pH		**8**	*1*	9	**7**	*0*	**7.55**
conductivity	µS/cm	**2758**	*633*	3820	**969**	*18*	**2400**
BOD	mg/L	**415**	*167*	750	**415**	*21*	**608**
COD	mg/L	**806**	*374*	1500	**558**	*82*	**869**
TS	mg/L	**2124**	*1112*	6340	**759**	*76*	**8090**
TDS	mg/L	**1508**	*499*	2345	**533**	*11*	**1638**
TSS	mg/L	**587**	*985*	4627	**226**	*65*	**6452**
Phosphate	mg/L	**5**	*2*	7	**4**	*0*	
Sulfide H_2S	mg/L	**15**	*9*	28	**6**	*2*	**3**
NO_2	mg/L	**0**	*1*	3	**0**	*0*	
NO_3	mg/L	**1**	*1*	4	**0**	*0*	
DO	mg/L	**0**	*0*	1	**0**	*0*	

Table 6: Display of El Moufty raw wastewater data per season (summer/winter)

SEWAGE SAMPLES	unit	El Moufty in summer (7 samples)			El Moufty in winter (13 samples)		
Parameter		**AVERAGE**	**SD**	**MAX**	**AVERAGE**	**SD**	**MAX**
Temperature	°C	**29**	*1*	30	**18**	*1*	19
pH		**7**	*0*	7	**8**	*0*	9
conductivity	µS/cm	**2083**	*106*	2286	**3121**	*469*	3820
BOD	mg/L	**256**	*91*	410	**507**	*134*	750
COD	mg/L	**393**	*146*	637	**1033**	*259*	1500
TS	mg/L	**1433**	*113*	1644	**2528**	*1240*	6340
TDS	mg/L	**1003**	*402*	1257	**1781**	*290*	2345
TSS	mg/L	**287**	*91*	492	**794**	*1246*	4627
Phosphate	mg/L	**3**		3	**5**	*2*	7
Sulfide H_2S	mg/L	**10**	*8*	28	**18**	*8*	28
NO_2	mg/L	**0**		0	**0**	*1*	3
NO_3	mg/L	**0**		0	**1**	*1*	4
DO	mg/L	**0**		0	**1**	*0*	1

The other data available is listed in Table 7. The review of this data raised a few critical observations:

- Great variations, even within the same study, make it difficult to draw safe conclusions on average or typical values
- Most of the data comes from analysis of the influent of WWTPs serving rural areas, thus its representativeness is questionable, since only 5% of the rural areas in Egypt are served by wastewater treatment facilities (Sabry and Sung 2011)
- Most data are snapshots in time, with no analysis of variations (yearly and daily); it thus also questions representativeness
- The conditions in which the samples have been taken an analysed is often not stated.
- Wastewater flow rates, when available, are largely based on assumptions. There is a big probability that these assumptions, especially the ones for water consumption, are not corresponding anymore to the current situation or are too general.

Table 7: Existing baseline data for sewage characteristics in rural areas of the Nile delta and Fayoum

Sources		**[1]** (Gaber and Bakr 1997)	**[2]** (Chemonics 2006)	**[3]** (Chemonics 2006)	**[4]** (Gemmell 1992)	**[5]** (Preul 1983)	**[6]** (Chemonics 1985)	**[7]** (Ibrahim 1995)	**[8]** (Abdel Wahaab 2010)	**[9]** (Abdel Wahaab 2010)	**[10]** (El-Gohary, Abou-Elela et al. 1998)	**[11]** (Sabry 2010), $^{(1)}$(Sabry and Sung 2011)	**[12]** (Sabry 2010), $^{(1)}$(Sabry and Sung 2011)	**[13]** (Sabry 2010), $^{(1)}$(Sabry and Sung 2011) [13]	**[14]** (ALRAED JetMaster)	**[15]** (Haroun 2011)	**[16]** BWADC Central Lab	**[17]** (Chemonics Egypt 1998)
Flow	[lcd]	100 (assum.)	60–100 up to 150	73		50-100 (estim.)			144					141			108 (estim.)	
BOD	g/cap.d	55(assum.)	30-60			26 (estim.)												
	mg/l	320-468	200-1000	565	203-461	500–800 (estim.)	657	393-696	381 (±84)	374 (±85)	282-909	286	508	114.3	629.3	450	300-560	425
COD	g/cap.d		70-150															
	mg/l		450-2500	885	524-917	600–900 (estim.)		991-1573	736 (±99)	665 (±165)		420	1113	700–1000 (1)	811.5	962	380-620	604
NO_3-N	mg/l							0-0.27				1.3			40			
NH_4-N	mg/l				46-59			37-70	61 (±10)	53 (±9)		48	61			26.2	30.1-55	
org.N	mg/l				51-78													
TKN	g/cap.d		8-12															
	mg/l		50-200													71		
TP	g/cap.d		1-3															
	mg/l		6-50					13-27	6.6 (±1)	6 (±1)			13.4 $PO4_3^-$			4.44		

Notes on the data in the table:

[1] Influent analysis in 8 rural WWTPs in Damietta, implemented during BVS and LDII-P projects (Adliya, Daqahliya, Kom El-Akhdar, Kafr Saad El-Balad, Barashiya, Kafr Soliman, Meit El-Kholy, El-Serw)

[2] General figures for rural Egypt

[3] Project: “Evaluation of Small Bore Gravity Drain Systems in Egypt”, in Nawag village, Gharbia (16’000 inhabitants)

[4] Analysis from 4 rural WWTPs in Damietta

[5] Estimations based on data for Ismailia from Metcalf&Eddy 1979

[6] Sampling in El Aadliya (Damietta)

[7] Analysis of influent of 5 WWTPs in the Nile Delta (Sharabas, El Battiekh, Daqahla, Adliya, El Barashia)

[8], [9] Study in Mit Dafr, Dakahliya (15’000 inhabitants)

[10] Evaluation of 5 different (types of) plants constructed as part of LDII-P and BVS. Sampling conducted during November and December 1993.

[11] Moshtohor village, 40 km North of Cairo

[12] Samples from wastewater pumping stations in Shawa, Meat El-Aamel, Nawasa El-Gheat and Nawasa El-Bahr (averages for the 4 villages)

[13] Measurements in Abd El Kareem Issa, Fayoum (~2000 inhabitants). The value of BOD is estimated from Fig. 5 of the paper.

[14] For Kafr El Hamam plant, May 2009

[15] Averages of the raw wastewater investigated in the study of Haroun. No information on the source of the wastewater

[16] Analysis of influent from Ariammon WWTP (17,23 Jan. and 4,14,25 Jul 2011) Estimation of flow based on an average water consumption of 135*0.8 L/cap/day.

[17] Average for all the governorates of the Nile Delta (Damietta, Dakahliya, Sharkiya, Qalubiya, Menufiya, Garbiya, Kafr El Sheikh and Beheira). Available raw wastewater data for each of the Governorates was reviewed and analysed by the authors.

3.3.2 Greywater

Main source of information regarding greywater in Egyptian villages is the dissertation of J. Stewart Gemmel “*Policy Analysis and Development for Liquid Waste Management in Rural Egypt*” (Gemmell 1992). Other studies use these findings (Chemonics 1990; Gaber and Bakr 1997; Gaber 2004) while, in an earlier report prepared by Chemonics (Chemonics 1989), values from international literature and assumptions are used to define the quantity and composition of “sullage” in rural Egypt.

3.3.3 Septage

Gemmel presents data on septage from Nikla el Enab as well. The analysis included ten samples of different ages obtained during one day (9 households and mosque). In only one of the households greywater was diverted into the vault.

Some information on characteristics of septage can be also found in (Gaber 2004) derived from the report "Technical Evaluation of Pilot Latrines in Fayoum Governorate" (IWACO et al. 1997).

Table 8 Characteristics of septage in an Egyptian village from Gemmel (2002)

Parameter		**Gemmel 1992**			**IWACO et al. 1997**
		Minimum	**Maximum**	**Average**	
pH	-	7.7	8.8	-	
BOD	[mg/l]	1'200	5'100	**2'750**	
COD	[mg/l]	3'768	8'256	**5'747**	
TS	[mg/l]	1'912	3'867	**3'179**	40'000
TSS	[mg/l]	727	2'466	**1'243**	15'000
TDS	[mg/l]	1'089	2'463	**1'713**	
TVS	[mg/l]	932	1'621	**1'284**	25'000
Sett. Solids	[mg/l]	10	80	**33.9**	
VSS	[mg/l]	11	1'150	**437.7**	7'000
Ammonia	[mg/l]	70	546	**272**	
TN	[mg/l]	54	800	**396.6**	
Oil and Grease	[mg/l]	69	482	**243.4**	

3.3.4 Gaps in knowledge

The available data is very thin. There are major gaps in knowledge about sewage, greywater, septage and animal liquid manure characteristics and quantities in the rural context. The number of sources is too limited and there is a high difference between studies and within the studies. Often the studies are old or do not correspond to the current situation anymore, where the water consumption has highly increased. Most of the time, the studies are not precise enough for the data to be used.

Studies so far are focusing mainly on big villages (more than 10,000 inhabitants), whereas smaller villages and *ezbas* (which often have very different conditions) are largely neglected.

There is a lack of information on temporal variations (seasonal or daily) and of reliable data regarding wastewater flows and water consumption.

There is almost no data on greywater and sludge emptied from on-site facilities, regarding both quantities and characteristics. No data could be found on the characteristics of liquid manure, or its influence on septage and sewage concentrations.

Above all, there is a great need to link characteristics and quantities of wastewater and its different components with the characteristics of the communities which produce it.

3.4 Reuse of wastewater, sludge and biogas

Wastewater reuse is a widely studied topic in Egypt (AHT 2009; IRG 2010; Abdel Wahaab and Mohy El-Din 2011). The availability of renewable water resources in Egypt has dropped from more than 2,000 m3/capita/year in 1966 to less than 1,000 m^3/capita/year today. At present population growth rate, this will drop even further to 600 m^3.capita/year by the year 2025, if the share of Egypt from Nile waters remains as it is today (55.5 BCM) and levels of per capita consumption are maintained (Abdel Wahaab and Mohy El-Din 2011). However, the current developments tend to show that Egypt's share will decrease in the coming years at the profit of upstream countries (e.g. Ethiopia) and per capita water consumption is increasing as the quality of the water supply system improves throughout the country. There is more than ever an urgent need to save water and reuse more.

Sludge reuse is also topical but much less studied. In the years 2000, EIB financed the "Cairo Sludge Application Study". The executing agency was CAPU and the consultant was the Water Research Centre (WRC) in England. The most common technology for sewage sludge treatment and disposal in Egypt is the drying bed. The dewatering time is usually 25 days in summer and 40 days in winter (Ghazy, Dockhorn et al. 2009). After that, the sludge is stored for a period of 1.5 to 6 months according to the weather and available stacking area conditions before utilization. The dried sludge is mainly used for land application or it is rarely dumped into landfills. Ghazy et al. (2009) note that the current wide-spread scenario of sewage sludge treatment does not contain facilities for sludge stabilization processes and that the quality of the produced sludge in most of the WWTPs does not fit in the Egyptian or international standards, especially pathogens limits. However, WWTPs sell sludge wholesale to "sludge traders" who then find customers. Direct sale to farmers is also observed.

Recently, there are some new scenarios for sewage sludge treatment, which have been developed in Egypt, especially in Cairo and Alexandria governorates (Ghazy et al., 2009). Anaerobic digestion technology is applied for sludge stabilization and power generation in Al Gabel Asfar WWTP (Cairo WWTP, serving more than 7 mios people). The windrow composting of dried sewage sludge is another scenario for sludge treatment in Egypt, applied in the Al Berka WWTP in Cairo and the "9N" site in Alexandria. Usually, sewage sludge is the primary material and one or more amendments are added to it such as rice straw as applied in Al Berka WWTP or old compost as applied in "9N" site. Sludge is mechanically dewatered by belt filter presses before being composted. Reuse for reclaimed desert land is currently the preferred option as the demand for sewage sludge on the reclaimed farms is likely to be high and any inputs of organic matter are valuable for water retention and nutrient supply (Ghazy et al., 2009).

Ghazy et al. (2009) did a preliminary market study for the sale of sewage sludge. The amount of dried sewage sludge produced at the drying beds of Al Berka WWTP is directly sold to farmers with a gate price of 8.20 US$/m3. The sale price of the produced compost from the pilot compost project in Cairo ranges from 8 –13 US$/m3. HCWW sells the produced dry sewage sludge to main contractors with a gate price ranging from 1.5-10.5 US$/m3, with average prices of 6.1 US$/m3. About 0.66 million tons of the dried sewage sludge have already been sold to farmers in 2007, which represent more than 85 % of the total produced sewage sludge from all WWTPs in Egypt according to HCWW data. Attractiveness of sludge can only rise in the future as the subsidies that the Government provides to support the fertiliser industry is going to decrease.

It has to be mentioned, however, that biogas collection and reuse as well as composting is usually not cost-effective in small-scale treatment plants. At the time of writing, an initiative funded by UNDF, GEF and Environmental Affairs Agency / Ministry of State for Environmental Affairs (EEAA / MoSEA) is testing household-level biogas digesters in Upper Egypt, fed with animal manure[3] (Reymond 2013). The biogas is intended for domestic use, such as cooking. Biogas digesters are very promising in such an area in a time where the price of the gas bottles is increasing drastically. Next to that, the farmers do not lose the manure as a fertilizer, as he can use the bioslurry (effluent from the digester), which has a better fertilizer value than fresh manure.

Research on biogas digesters for rural areas has also been carried out by the Soil, Water and Environment Research Institute (SWERI) of the Agricultural Research Centre (ARC), in their training centre located in Moshtohor village, 40 km North of Cairo (El-Shimi and Arafa 1997; Shehata, El-Shimi et al. 2004).

Dry wastewater sludge from Sedi Salem WWTP, Kafr El Sheikh

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[3] Project “Bioenergy for Sustainable Rural Development (Biomass)”: www.egyptbiomass.com

4 Results of interviews, surveys and field observations

This chapter compiles the results of the field work which includes:

- Visit of 44 villages
- Deeper studies in 6 selected villages, consisting of:
  - 168 household surveys
  - 5 interviews with bayara emptiers
  - 14 interviews with farmers
  - 3 interviews with persons responsible for sewer maintenance
  - 3 interviews with persons responsible for non-domestic buildings

This work leads to a clear picture of the current practices and defines precisely the situation in the 6 villages under investigation.

Semi-structured interview with a sheikh al balad and village representatives (left) and a household survey in Beheira Governorate (below)

4.1 General characteristics

4.1.1 Selected villages

During the first campaign, the three following villages were selected (the field notes with satellite images are provided in Appendix 2):

- **El Ashara (markaz Abu Hommus)**: village with density below average and on-site sanitation systems (bayaras); supportive *sheikh (Sheikh Mohsen Saad),* who is respected in the village
- **El Hamamee (markaz Abu Hommus)**: very dense village inhabited mainly by poor workers, informal sewer network facing important problems
- **Kabeel (markaz Damanhur)**: village with a denser part built on a hill and a newer part being developed around it, both informal sewers (with problems) and on-site systems are used, friendly *omda* (*Omda Abd el Wahab Hagag*).

During the second campaign, the three following villages were selected out of the list provided by ISSIP PMTA (Hydroplan 2013); more information and satellite images can be found in the field report provided in Appendix 3:

- **Manshet Nassar (markaz *Damanhur*)**: village with an average density and an informal sewer network; 2 sewer lines where sampling is possible. Supportive Sheikh *(Mosaad Nassar)*
- **El Hadery (markaz Abu Hommus)**: village with low density and only on-site sanitation system, high number of cattle. No sheikh but supportive influent villager (*Nabil El Tanikhi*)
- **Kawm an Nuss (markaz Kafr el Dawar)**: really dense village, built on a hill, informal sewers (with problems) serving most of the village and discharging in a drain 2 km out of the village. Some isolated buildings still rely on bayaras.

During the third campaign, the two following villages were selected. They were chosen because they had an informal sewer network offering the possibility to take samples; more information and satellite images can be found in the field report provided in Appendix 4:

- **Kawm Abo Khalifa (markaz *Damanhur*)**: village with a high settlement density and an informal sewer network; a small part of the village is using bayaras; one outlet with a possibility to take samples
- **Fisha Al Safra (markaz *Damanhur*)**: village with a medium settlement density relying almost exclusively on sewer networks, with seven main lines and the same number of outlets discharging into the drain.

The location of the eight villages is featured on the satellite image below (Figure 2). All eight are within ISSIP area (Mahmudeya Command Area). A KMZ file, which allows visualising the villages on Google Earth, is available upon request.

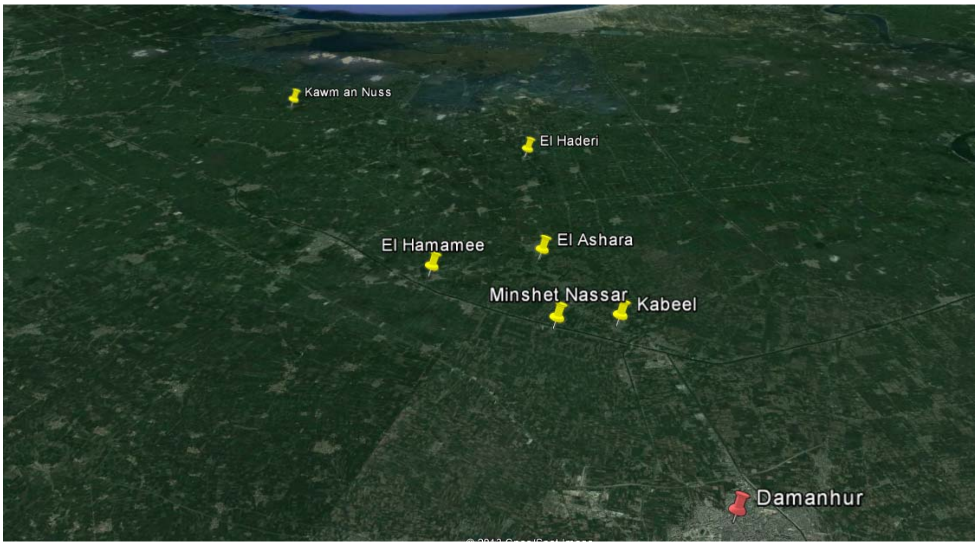

Figure 2: Satellite image featuring the 6 studied villages in Beheira Governorate

The main information on the six selected villages is given in Table 9, with the more detailed table provided in Appendix 5.

Table 9 Main characteristics of the selected villages

	Population (census 2006)	Sanitation system	Density	Building repartition	Quality of water supply (interruptions/pressure)
Ashara	2252	Bayaras	Low	Low density	Bad
Hadery	1854		Low	Low density	Low pressure
Kabeel	1762	Sewer + Bayaras	High & Low	Nucleus	Low pressure
K. Nuss	3000[4]		Very high	Nucleus	Bad
K. A. Khalifa	4070[4]		High	Nucleus	Bad
Fisha el Safra	2630[4]		Middle	Nucleus	Good
Hamamee	730	Sewer	Very high	Nucleus	Good
M. Nassar	1917[5]		Middle	Linear-Nucleus	Good

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[4] Estimation from the ESRISS team (see §4.1.2), based on the number of houses and the number of inhabitants per house.

[5] Census 2012

Table 10 gives an overview of the main characteristics of the studied villages as obtained through the surveys. Appendix 14 gives the average result (per village) for most of the questions of the household survey; it also includes the number of answers, the standard deviation and/or the range of the answers.

Table 10: Summary of the results from the survey

	Village population	Proportion of farmers	Number of animals	Sanitation system		Water consumption
				Bayaras	Sewer	
	[cap]	*[%]*	*[cow/cap]*	*[%]*	*[%]*	*[L/cap/day]*
Ashara	2252	50%	0.278	100%	0%	-
Hadery	1854	80%	0.505	100%	0%	59
Kabeel	1762	38%	0.064	20%	80%	-
K. Nuss	3000	54%	0.11	5%	95%	86
K. A. Khalifa	4070	83%	0.29	10%	95%	74
Fisha	2630	48%	0.27	5%	95%	104
Hamamee	730	16%	0.04	0%	100%	-
M. Nassar	1917	39%	0.141	0%	100%	110

4.1.2 Population

The selected villages count from 700 to 4000 inhabitants. The census date back from 2006, but the number of people does sometimes not fit with the observations. In Kawm an Nuss the census announces 1500 inhabitants; given the size and the density of the village it seems to be closer to 3000. The number of inhabitants has to be cross-checked with other methods: personal observations and count of buildings. In all case it cannot be estimated only through satellite images, as the situation changes quickly, and accelerated expansion has been experienced since the revolution in 2011; what is more, satellite images do not allow the assessment of the number of storeys.

There is a big variation regarding the main occupation of the villagers, as shown in Figure 3. In richer villages, most people are farmers (who do not necessarily own the land they cultivate), while poor villages have a higher proportion of workers having temporary jobs (e.g. building construction). The proportion of people working out of the village may have an impact on the wastewater production, but it could not be assessed in this study.

The number of cattle (cows, buffaloes) varies from 0.04 to 0.5 cows per inhabitants or, assuming 4.7 inhabitants per household, it varies from 0.2 to 2.3 cows per household. The proportion of buildings with cattle varies from 20 to 80%. These variations can be correlated with the proportion of farmers in the population. Farmers bring their cattle to their fields every day and do not need to buy fodder. In Hadery, where the highest proportion of farmers was observed (80%), the number of buildings with cattle and the number of cattle are both significant.

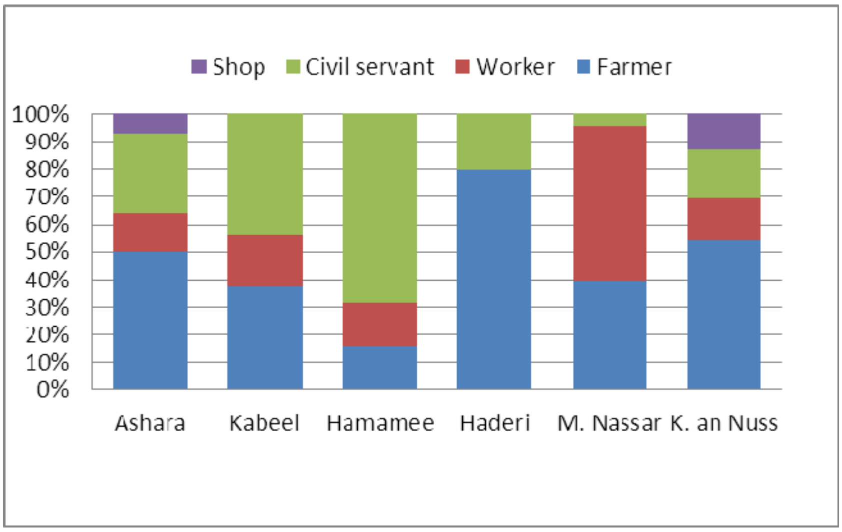


Figure 3: Socio-professional profile of each village

4.1.3 Village features

Ezbas in the Nile Delta are quite heterogeneous. Here are a few relevant differences from one village to the other (cf. also Reymond et al, 2012):

- close to a main canal or drain vs. surrounded by agricultural land
- «nucleus» vs. «linear» shape
- high vs. low groundwater table
- divided by various numbers of smaller drains and canals
- high density vs. low-density housing (e.g. influenced by distance between buildings, presence of yards, number of floors)
- different small-scale industrial activities: cattle farms, chicken farms, plastic granule factory, cheese factory
- informal sewer network (or “groundwater lowering” network) vs. bayaras or both

The nucleus form can be found in old villages, in the middle of fields (Figure 4, right). The old part is usually built on a small land elevation (sometimes mentioned with the word “kawm” in the village name) with a high building density and narrow, non-straight streets. It is surrounded by the new part with less-densely built concrete buildings. Most of the villages visited with this form were equipped with a sewer network. Indeed the lack of space and the difficulty for trucks to access the bayaras make the on-site sanitation systems less adequate. Besides, the slope eases the construction of a sewer network.

The linear shape appears in villages built along canals, drains or a roads (Figure 4, left). When the village is placed close to a canal, the groundwater level can be very high (up to 50 cm in M. Nassar). Such villages have a lower building density.

There also villages with a relatively lower density, especially in the north of Beheira Governorate (e.g. Hadery El Ashara), as shown in Figure 5. It is characterised by lower buildings, with wide spaces in the village. Some villages have courtyards next to each building and the average building does not have more than 2 storeys.

Figure 4: A linear shape (Iz.Bullis, left) and a nucleus shape (Iz. Wahby,) - Gharbeya

Figure 5 Low density shape (Hadery)

A low-density village (above) vs. a high-density village (right)

4.1.4 Buildings and households

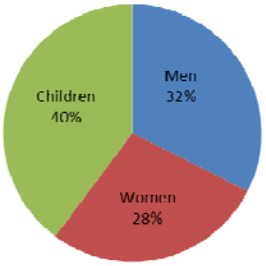


Figure 6 Proportion of men, women and children

Most buildings are family buildings. Each floor is usually for one son and his family, with the parents living also in the same building; it results that buildings are usually not finished in order to give the possibility to build another floor for future family expansion. The density is always increasing.

Based on village average, the number of inhabitant per building varies from 7 to 14. This number depends on the village density and the wealth of inhabitants. Rich people tend to build big buildings and host all their family, with up to 30 people in the same house. Denser villages have higher buildings and more people in it. A building is almost always composed of several households, with an average of 2.5 households/building. The number of inhabitant per household is in average 4.7 (based on data from 5 villages). The proportion of men, women and children almost does not vary from one village to the other (Figure 6).

Every building has drinking water supply with more than one tap and almost all of them are equipped with a washing machine for laundry.

These results were obtained through the Q1-2 of the household survey questionnaire (Appendix 8). The average answers for each village can be found in the *Main observations* section of Appendix 14.

4.1.5 Non domestic buildings

Mainly three different types of non-domestic buildings are present in small villages: mosque, school and health centre. There are 0 to 3 mosques per village, not more than two schools and a maximum of one health centre. Mosques produce really diluted wastewater, mainly generated by the ablutions; it thus has characteristics close to greywater. In general it seems that non-domestic buildings have an insignificant impact on the wastewater volume and loads compared to what is produced by the households (cf. ESRISS *Material Flow Analysis* report). There was no industry in the six selected villages.

The general characteristics of non-domestic buildings were assessed through ESRISS teams observations, Q11-12 in the questionnaire for the village authority and representatives (Appendix 6) and Q28-30 in the questionnaire for the bayara emptier (Appendix 9). Precise questions were asked in the questionnaire for the persons responsible of non-domestic buildings (Appendix 12).

4.2 Current sanitation practices

Among the eight villages visited, two have only bayaras, two only sewers and four a combination of both systems (see Table 10).

4.2.1 On-site systems

Bayaras are simple vaults (cesspits), receiving all blackwater, part of the greywater and sometimes liquid manure. They are placed right outside the building. Out of the three studied villages equipped with bayaras (three had less than 10% of bayara, therefore not taken in account), two had sealed bayaras and one had unsealed ones in order to favour exfiltration of wastewater into the ground. However, in the latter, it seems that, in fact, more infiltration (i.e. groundwater entering the bayara) occurs than exfiltration, as the bayaras are often deeper than the groundwater table. In the two other villages the vaults are sealed, with walls out of bricks plus a cement layer and a concrete bottom, to avoid interaction with groundwater. As a general observation, it is possible to say that the main driver is to reduce the emptying frequency. Consequently, if people perceive that the groundwater level is deep, they will build unsealed bayaras. If the groundwater level is high, they will build sealed bayaras.

Inside a sealed bayara (Photo: L.Ulrich)

The volume of a bayara (9-15 m^3) varies according to the size of the household. On average, they are emptied every 10-30 days in several trips for an average fee of 25 EGP/trip. Emptying is done mechanically by trucks, which transport and discharge the septage in the nearest drain. Although village councils usually own one truck, the majority of them are privately owned. Bayara emptying is thus mainly an informal private business. As a consequence hardly any record is kept. People who need a service wait until a truck passes by or call the driver directly.

Bayara emptiers mentioned that one of the problems they face in their business is that streets are sometimes too narrow and the *bayaras* are not accessible. In such a case, household members have to buy long rubber pipes to connect their *bayara* to the truck. Another problem mentioned is the thick mud on the streets during winter. Finally, while discharging septage directly in the drain is illegal, the emptiers interviewed did not mention any particular problems with the police.

The total amount of septage produced is still not clear because of the difficulty to measure the infiltration/exfiltration. In Hadery, the volume computed based on the frequency of emptying gives an amount of 110 L/cap/day, while it amounts to 70 L/cap/day when estimated through the amount of water discharged in sanitation system and the estimated infiltration. Further study need to be done.

On-site system characteristics were assessed through observations during the field visits, an entire chapter (Q23-34) in the household survey questionnaire (Appendix 8) and through the interviews with the bayara emptiers (Appendix 9).

A bayara emptier between the village and the drain

Septage discharge into the drain

4.2.2 Informal sewer systems

Informal sewer systems are simple networks of pipes, usually installed by the inhabitants themselves, discharging the untreated wastewater to a water body close by. They are made of plastic pipe with a diameter from 4 to 8 inches, in an average depth of 1 m. Manholes are usually built at each junction. Generally villages do not have only one network, but several (up to 7), each with a different outlet. Due to the lack of expertise in design and construction, these sewer networks often face serious problems and sometimes fail to serve their purpose as conveyance systems. Due the high water table and the poor quality of the network design, it can be subject to significant infiltration.

Maintenance of the sewers is done by either a worker assigned to this task or the inhabitants themselves. In one studied village, a villager was responsible for the sewer maintenance; the village instituted a fee of 40 EGP per household per year to cover the costs. Clogging occurs on average one time per week per subline. Different methods were observed to prevent clogging or unclog the sewer:

- Pumping canal water directly into the network, either through a pipe introduced directly into the network (Kawm abo Khalifa), through a bayara emptying truck (Kawm abo Khalifa, Kawm an Nuss), or through an installation which brings pumped water directly into a manhole (al Jammamizah)
- Modified manholes (Fisha): The main line passing in the manhole is not open; it consists of a perforated pipe which prevents solid waste to enter the sewer system.
- Interceptor tanks (Tarabees): small bayara in front of each house, allowing the settling of solids. The overflow of the bayara is connected to the network.
- Forbidding the discharge of liquid manure in the network is practiced in some villages (e.g. Kawm an Nuss).

The older sewer network seen was 30 years old (in M. Nassar). Because it allows eliminating the burden of the bayaras (high emptying frequency, limitation of water consumption) a consequent number of villages are now investing in informal sewer networks.

Informal sewer characteristics were assessed through observation during the field visits, through an entire chapter (Q15-22) in the household survey questionnaire (Appendix 8) and through the questionnaire for sewer operators (Appendix 10).

Improvised way to avoid overflow of sewage; next to it, storm water on the street. (Photo: L. Ulrich)

Villager unclogging a sewer pipe (Photo: L. Ulrich)

4.2.3 Management of animal manure

In the vast majority of the households owning animals, animal urine and faeces are collected separately. The solid part of the manure is collected and transferred to the fields for application, either directly or after a period of storage, depending on the time of the year and the type of crops. The stables have most of the time a naked concrete floor, allowing the liquid part to be drained either directly to the sanitation system (25%) or, more commonly, to a collection hole (75%). These holes can be of different sizes, closed or open, inside or outside the stable. They are emptied once or twice a day and their content is discharged either in a canal, in a drain or on the street according to the situation. The first emptying is usually done between 7 and 8 am, which may increase considerably the nutrient and COD loads in sewage at that time, thus creating a peak. The liquid is sometimes transferred to the fields along with the solid part (Figure 7 – see also the section on reuse - §4.6). Straw may be used to absorb part of the urine in the stables, which facilitates later transport onto the fields. Farmers do not clean their stable with water.

Inside a stable with concrete floor and a small drain leading the liquid manure into the collection hole (Photo: L.Ulrich)

A collection hole, with the buckets to transport the liquid manure to the nearest disposal point (Photo: L.Ulrich)

Figure 7 Place of discharge of liquid animal manure

In villages relying on bayaras, the proportion of manure discharged in the bayaras lies between 0 and 25% (2 villages). In villages equipped with sewer network, it varies between 9% and 65% (6 villages). When there is a rule forbidding such discharge in a sewer network, this amount is lower (about 9% in K. Nuss). Indeed the liquid manure is accused to contribute to the blockages. The discharge on the street is systematically less than 20%. The rest ends either in a nearby water body or on a field.

The number of cattle and the proportion of liquid manure discharged in the sanitation system have a significant impact on the quantity of nutrients and the oxygen demand in the produced wastewater. In Hadery, the number of cattle per inhabitant is high (0.5 cattle per inhabitant) and 25% of the liquid manure is discharged in the sanitation system. In this case, the liquid manure represents ca. 25% of the total nitrogen loads in wastewater (cf. ESRISS *Material Flow Analysis* report).

These results are derived from observation during the field visits, an entire chapter (Q35-40) in the household survey questionnaire (Appendix 8) and through the questionnaire for sewer operators (Appendix 10)

4.2.4 Storm water management

No storm water management practices were observed in the villages investigated; storm water is usually left to dry on the streets or derived in the sewer networks where existing. This causes severe problems in villages with no paved streets, like Ashara, where the thick mud on the streets during the rainy season makes circulation in the village almost impossible. Besides, when derived into sewer networks, storm water from muddy roads tends to clog the sewers.

Storm water management was assessed through observation during the field visits, interview to village authorities and representatives (Appendix 6) and Q24-25 in the questionnaire for the sewer operator (Appendix 10).

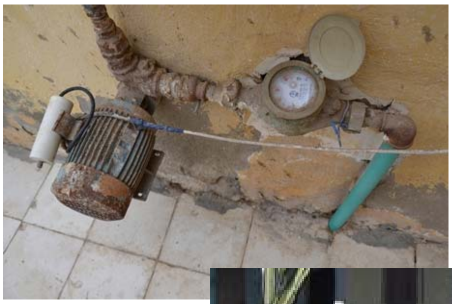
Storm water blocking village streets during the rainy season - Beheira (Photo: L.Ulrich)

4.3 Water supply

Every building has water supply and a few taps. The water consumption as read on the water meters in five villages varies from 60 to 110 L/cap/day (Appendix 14). Two main factors explain this variability:

- **Type of sanitation system:** households with on-site sanitation system tend to reduce their water consumption in order to minimize the filling of the bayara. In Hadery, a village which has a problem with the very frequent overflowing of bayaras, the average water consumption is 59 L/cap/day (based on 11 readings).
- **Quality of the water supply system (interruption and pressure):** in households connected to a sewer network the consumption is limited by the quality of the water supply systems. In Kawm an Nuss, where the water supply is mediocre (frequent interruption and low pressure - see §4.8 about the Problems faced by the population), the average consumption is 86 L/cap/day (based on 9 readings), whereas it is 110 L/cap/day (based on 16 readings) in M. Nassar, which is located close to a drinking water station with a much better water supply.

In every village, some households (25 to 70%) imports water from other sources than the household tap, such as wells or canals (for washing purposes). This is caused by too frequent interruptions and/or by the low pressure in pipe. The average imported water is lower than 5L/cap/day.



A water meter and a house pump in Beheira

Women washing the dishes in a canal (Photo: A.Papangelou)

The water consumption is a crucial data for the estimation of wastewater production. Reliable data in a specific village can only be obtained through water meter readings extended over a certain period. It has to be taken in account that a large number of water meters, 15-20%, are difficult to read, or are just not working. The estimation of water consumption shall not be based on the price paid by household for water; field work shows that it does not reflect the real water consumption, that it is often a lump sum and sometimes fixed by the water company collaborator on a basis that may be random (cf. §4.7.1 Costing of current situation – Drinking water).

Table 11 provide an estimation based on the two criteria mentioned before.

Table 11 Estimation of daily water consumption

	Good water supply	Bad water supply
Onsite sanitation	60 L/cap/day	60 L/cap/day
Sewer network	110 L/cap/day	90 L/cap/day

4.4 Greywater production

Even if almost every household is equipped with a sink and washing machine, not all the greywater is discharged into the sanitation system. Many people are doing the laundry and/or the dishwashing outdoor and discharge the water on the street or in a water body nearby (drain/canal). The type of sanitation system has a big influence on this practice, as people having bayara tend to minimise the volume of greywater ending there. Consequently, our observations show that almost half of the production of greywater ends directly in the environment without going through the sanitation system, as featured in Table 12 (results based on 6 villages with around 20 answers per village).

Table 12 Percentage of greywater entering the sanitation system

	% ending in sanitation system
Onsite sanitation	45-60%
Sewer network	75-100%

The greywater production and place of discharged were obtained through observations during the field visits and Q12-14 in the questionnaire for household (Appendix 8).

4.5 Blackwater production

There is an average of 4.6 people per toilet and there is small variation between villages (4.2-5.2 cap/toilet) (Appendix 14). Houses have in high majority squatting toilets (80-100%), otherwise sitting toilets. Squatting toilets are bound to a pour-flush system which consume about 2.3 L/flush (measured during surveys), while sitting toilets have cistern flush, which consumes in average 8 L/flush. It has been observed that people having both types of toilets prefer to use the squatting one. The estimation of 5 flushes per person per day leads to a black water production of 12-20 L/cap/day

Blackwater production was assessed through observations during the field visits and Q1 and Q4 in the questionnaire for household (Appendix 8).

4.6 Reuse practices

Reuse is an important topic in a resource-scarce country like Egypt. If wastewater reuse in the country has been widely studied (cf. §2.1 – *Literature review*), it is not the case for the reuse of sludge, animal manure, and, in general, the nutrients from sanitation (nitrogen and phosphorus). Besides, if reuse has been so far considered and implemented in big centralised treatment plants, a strategy for reuse at a small-scale level is still to be developed. Given the fact that the demand on freshwater supplies is increasing, it is clear that small-scale WWTPs at the village level would be an opportunity for localised reclamation/reuse (Abdel Wahaab and Mohy El-Din 2011).

Reuse practices were assessed through observation during the field visits and interviews, namely: Q9-24 in the questionnaire for farmers (Appendix 11); Q22-25 in the questionnaire for bayara emptiers (Appendix 9); Q5 and Q14 in the questionnaire for village authorities and representatives (Appendix 6); Q46, 55 and 60 of the extended household survey (Appendix 7), resp. Q29 and 37 in the shorter MFA survey version (Appendix 8). Information has also been collected during the assessment of existing infrastructure with the “evaluation questionnaire for small-scale sanitation initiatives” (to be found in (Reymond, Abdel Wahaab et al. 2012)), through the questions in section 3 (*Nutrient recovery & reuse options*) and section 7 (*Socio-cultural acceptance: awareness, behaviour and participation*).

4.6.1 Wastewater reuse

Wastewater reuse is widely practiced, mostly indirectly (i.e. treated wastewater is discharged in canals and drains and is pumped again for irrigation) and sometimes directly (e.g. the examples of forests linked to WWTPs in Upper Egypt). Reuse of water from the drain is illegal, but still practiced, especially when the level of water in the canal is too low, according to an interviewed farmed.

In the delta, indirect reuse in agriculture has been observed, as well as wastewater reuse in aquaculture ponds (fish farming). The latter has been observed in the north of Kafr El Sheikh and Beheira governorates. Such practice is very common in Asia.

Direct reuse of the treated effluent in agriculture is complicated, as there is a discrepancy between the effluent flow throughout the day and the times where irrigation water is needed. In other words, the effluent should be stored for the farmers to be able to use it when needed. However, effluent storage means extra-space, and space is very limited in the delta. The in-drain polishing with waste stabilisation ponds, as proposed by ESRISS Project (Reymond, Abdel Wahaab et al. 2012) and ISSIP Project (Hydroplan 2013), provides a solution for that. The pond system is built in a drain, thus avoiding the sacrifice of agricultural land, and the last pond is planned for irrigation purposes.

Only one of the interviewed farmers mentioned that septage from *bayaras* is applied on the fields, although very rarely and not in a systematic way. The bayara emptiers also confirm that this practice is rare, with one mentioning that it happens especially in summer; another one was observed while discharging into a small irrigation canal for a banana plantation. Septage has too high concentrations of organic matter and nutrients to be applied directly; thus, it can only be used during irrigation time, in order to dilute it and apply it evenly. However, irrigation rarely coincides with a full truck passing by the field. It can be considered as fortunate, as septage also contains very high concentrations of pathogens. In general, it can be assumed that people are aware of the nutrient content of septage, but also of the risks of applying it raw. At the same time, it should be kept in mind that bayara emptiers may be reluctant to admit discharge onto fields and into irrigation canals, as it is perceived as a negative practice.

4.6.2 Reuse of sludge and biogas

In terms of direct reuse, farmers are willing to use wastewater and sewage sludge in their fields (75% and 71% of the interviewed farmers respectively), given that it is treated and does not pose any health risks.

Interviews and observations done during visits of existing centralised treatment plants have shown that sludge is widely reused by neighbouring farmers. Sludge may be given or sometimes sold. In Khayata WWTP (Damietta Governorate), the operators said that the sludge from drying beds was removed and dried for further six months before being sold to farmers for a price varying between 15-30 EGP/m3. Many operators were aware of the health risks related to sludge that is not stored long enough before application in agriculture.

A usual practice is for an Affiliated Company to sell their dewatered sludge to a private contractor who then resells it to farmers. The private contractor is also responsible for removing the dewatered sludge from the drying beds in the WWTP. Sludge needs to be removed and hauled out of a bed manually. Since the private contractor resells the sludge, his schedule is dictated by the needs of his customers

In Kom el Naggar (Gharbeya), the original plan for the ESDF-funded WWTP included space for co-composting (composting with a mix of dried sludge and agricultural waste) (ESDF 2009). Unfortunately, this activity never really succeeded, for lack of interest and, maybe, too high costs for the logistics and processing.

The use of biogas is becoming increasingly attractive, as the price of the gas bottles is drastically rising. It is shown by the project implemented in Upper Egypt (cf. §3.4). The experience of this project in Fayoum shows, however, that farmers may still be reluctant to produce biogas out of their own excreta. They prefer to do it with animal manure only. This reluctance may be overcome with awareness-raising.

4.6.3 Reuse of manure and use of fertilisers

As detailed in § 4.2.3 (*Management of animal manure*), the liquid and solid part of animal manure are collected separately. A systematic reuse of the solid part is observed. It is usually brought on a cart to the fields and applied on the land, after a storage time of 2 to 6 months. 6 farmers out of 14 interviewed mentioned that they are buying manure, which proves its economic value; manure is reported to be sold between 10 and 25 EGP/m^3. One farmer said that he needs 40 m^3 of manure per feddan[6] per year. Traditionally, a small part of the cow dung is dried (e.g. against house walls) and used as a fuel in the outdoor earth-ovens, where women bake bread among others.

Part of the liquid manure is mixed and absorbed by solids, especially straw which covers most of the stables; dry solid manure is sometimes also used as an absorbent; in both case, the whole is transported to the fields. The fraction that is not absorbed is most of the time not reused, although most farmers know the value of it. The main constraints are:

- Transport: interviews with 10 farmers showed that their land is in an average distance of 1 km from their home. Liquid manure is heavy and not so easily transportable as solid manure.
- Application: liquid manure is very concentrated, which could damage the plants if applied raw; it has to be mixed with irrigation water.

Only a few farmers told that they would bring liquid manure to the fields. Most of them use to dispose of it into the drains or in empty spaces in and around the village. Part of it also ends up in the sanitation system (see §4.2.3).

Farmers in the Nile delta usually work on a limited amount of land (average of 40 kirats - about 0.7 ha, out of 13 answers). The use of manure is complementary to the use of chemical fertilisers. All the farmers interviewed use chemical fertilisers, which they buy either on the market or to the Agricultural Association, where it is a little bit cheaper but where the amounts are not sufficient. Table 13 shows the prices for the different types of fertilisers from both providers and the average consumption per farmer. In average, farmers spend 3450 EGP/year for fertilisers on the market and 1750 EGP/year at the Agricultural Association. It makes solid manure financially attractive, even if the fertilisers are still heavily subsidised.

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[6] 1 feddan = 24 kirat = 60 metre x 70 metre = 4200 square metres (m^2) = 0.42 hectares = 1.038 acres

Table 13: Average prices and consumption of the main chemical fertilisers

Fertiliser	Average price in the Agricultural Assoc. (per 50 kg bag)	Average price on the market (per 50 kg bag)	Average consumption (number of bags per year)
Nitrate	73	155	11
Urea	75	151	9
Potassium	63	178	ND
Phosphate	48	52	8

It has to be mentioned that a large firm named ECARU[7], specialised in composting of municipal solid waste and agricultural waste use to collect animal manure in the area where its factories are.

Solid animal manure applied onto fields

Cattle spending the day on the field and storage of solid manure.

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[7] www.ecaru.net

4.7 Costing the current sanitation situation

The following section exposes the costs that the inhabitants of the villages under investigation currently bear for drinking water and sanitation, both for bayara emptying and construction and maintenance of informal sewer networks. In all cases, the study shows that the costs are highly variable. Next to that, it shows that people in villages have to pay much more for sanitation than people living in big cities like Cairo.

4.7.1 Drinking water

The water consumption was computed in three villages through several readings of the same water meters (see §4.3). The price paid for drinking water, as well as its variation between summer and winter, was obtained with the household survey questionnaires (Q11, Appendix 8).

It shows that the water bills are not directly linked to the building consumption. The water company reader comes from one time per month to one time every four month (answers from several household in K. Nuss) and seems to give fixed bills (i.e. lump sums). 20-25% of the interviewed households have water meters which are not readable or are just not working, which tends to prove the non-proportionality of water bills, and the sometimes random basis of the price.

Officially the price of water is digressive depending on the water consumption (Table 14). Prices may have increased a bit in 2013.

Table 14 Tariff system in the governorate of Beheira (Values in 2011, Appendix 15)

Consumption [m^3/month]	**1-10**	**10-20**	**20-40**	**>40**
Price [EGP/m^3]	0.23	0.35	0.45	0.5

The fees were checked in the three villages of the second field campaign. The computed amount is uncertain due to the approximate answers of villagers, but draw a general idea the prices. The average price vary between 0.7 (K. Nuss) to 1.1 (M. Nassar) EGP per cubic meter. Even if these values are highly variable (e.g. standard deviation of 0.54 in M. Nassar), they are systematically higher than the official price. Due to a high variation within the same village, no comparison between villages can be drawn.

On a per capita basis, the average fees for drinking water in villages vary from 13 (in Ashara) to 42 EGP per household per month (in M. Nassar) or between 2 and 5 EGP per capita per month.

4.7.2 Bayara emptying

Emptying of the *bayaras* is a significant burden for the household budget in villages served by such on-site facilities.

One trip of a privately owned emptying truck costs on average 25 EGP (based on the answers of 30 households in 3 villages and of four bayaras emptiers). Public trucks are generally cheaper, but they are less frequent and they mostly stay in the mother-village. In Kabeel, a public truck (not from the village) cost 8 EGP/trip but was only used by 20% of the inhabitants. The public truck of Besentway cost 8.5 EGP/trip but add a tax for trips outside of the village. In Hadery none of the interviewees used or knew the price of a public truck.

80% of interviewees in Ashara and 60% in Hadery say that they empty completely their bayara each time. This implies that the truck makes 1-8 trips per bayara depending mostly on the size of the on-site sanitation system. On a village average, the truck makes 2-3 trips per bayara.

The frequency of emptying is high (on average, every 10-30 days – see §4.2.1). In some villages, there is seasonal variation with a lower frequency summer. In Ashara, emptying occurs on average every 20 days in summer and every 25 days in winter. This leads to an annual cost of 1050 EGP per house per year or 130 (±60) EGP/cap/yr (based on the answers of 11 households). This is not the case in Hadery, which may be caused by constant infiltration of groundwater. There, emptying occurs on average every 10 days, there is an average of 3.1 trips per bayaras and private emptying costs 25LE/trip. This leads to an annual cost of 1800 EGP per house per year or 340 (±150) EGP/cap/yr (based on the answers of 14 households).

Costs of on-site systems were assessed through interviews, namely Q27 and 30 in the household survey questionnaire (Appendix 8) and Q14-15 in the questionnaire for bayara emptiers (Appendix 9).

4.7.3 Informal sewer networks

In villages with an informal sewer network the regular expenses related to sanitation are much lower. Even though such networks need very frequent maintenance works (mainly unclogging), the cost does not exceed 2-3 EGP per household per month. The average expenses of a household related to the informal sewer network are:

- The share that each household pays for the installation of the main lines of the network, which varies a lot from one village to the other (150-1200 EGP/household); on average it amounts to about 530 EGP/household (based on the answers of 35 households in four villages).
- Installation of the household connection varies also from one village to the other (350-1000 EPG/household); on average, it is 550 EGP/household (based on the answers of 41 households in four villages).
- Costs for maintenance amounts from 0 EGP when villagers fix the problems themselves to 40-50 EGP/household/yr when there is a person responsible for maintenance.

Assuming a lifetime of 20 years for the main network and the household connection this amounts to less than 25 EGP/cap/yr.

The price of informal sewer network was assessed through interviews, namely Q20 in the household survey questionnaire (Appendix 8) and Q22 and 27 in the questionnaire for the sewer operator (Appendix 10).

4.7.4 Synthesis of water and sanitation costs

Table 15 compares the costs paid for water and sanitation in the six first villages under investigation. It highlights the very high costs that the villagers relying on traditional bayaras have to pay, sometimes 20 times more than those served by governmental sewer systems. On the contrary, it shows how insignificant the amount paid for wastewater services from the water bills is.

Looking at these costs, it is well understandable that organised communities are willing to collect the amount of money needed to build a sewer network. The data show that the investment is offset only in a few months to about three years, depending on the village situation. It is however important to note that most of these “informal” sewer systems are not built according to the state-of-the-art, but are rather the cheapest and shallowest pipe networks able to transport the wastewater to the nearest drain. If villagers would build proper shallow sewer systems, the price would certainly be higher. However, on the medium term, in most cases, it would still certainly be more cost-effective than keeping the bayaras.

Case-by-case financial comparisons should be made in order to encourage villagers to invest. If the investment costs are too high to be paid at once, leasing mechanisms could be thought of, with monthly payments that are inferior with the amount currently paid for bayara emptying.

Table 15: Comparison of the water and sanitation costs in sewered and non-sewered villages

	Unit	Haderi *bayaras*	M. Nassar *sewers*	K.Nuss *sewers*	Ashara *bayaras*	Kabeel *bayaras*	Hamamee *sewers*
Drinking water consumption	*L/cap/day*	60	110	86	N.A.	N.A.	N.A.
Drinking water ***(based on water bill)***	*LE/cap/mon*	2.5	4.9	2.1	2.1	3.4	2.3
- ***Amount for WW services if 35% of the bill***	*LE/cap/mon*	*0.9*	*1.7*	*0.7*	*0.7*	*1.2*	*0.8*
- ***Amount for WW services if 50% of the bill***	*LE/cap/mon*	*1.3*	*2.5*	*1.1*	*1.1*	*1.7*	*1.2*
Bayara emptying	*LE/cap/mon*	28	-	-	16	7.4	-
CAPEX for sewer connection	*LE/cap*	-	42	125	-	-	26
CAPEX for main sewer line	*LE/cap*	-	70	138	-	-	25
O&M informal sewer network	*LE/cap/mon*	-	*self-done*	3.3	-	-	0.3

4.8 Problems faced by the population

People in the villages face serious problems with the water and sanitation infrastructure. Even if most households are connected to the water supply network, most of them reported problems with drinking water, such as interruptions and low pressure.

In three villages (Ashara, K. Nuss and Hadery), 60-95% of the household members interviewed suffer from frequent and long lasting interruptions. Also, in these villages, 70%-100% of households face problems with water pressure. Most households are equipped with a pump which is sometimes even necessary for the ground floor. In Kabeel and Hamamee the situation is better with around 50% of the inhabitants complaining about the pressure and interruption. In M. Nassar, which is located close to a drinking water plant, the situation is much better.

Bayaras are only considered as a problem when they overflow. This occurs systematically in Hadery, where wastewater puddles could be seen even in the dry season (May). In this village the bayaras need to be emptied on average every 10 days due to infiltration of groundwater. Other problems mentioned are the bad smell, gathering of mosquitos and the presence of humidity in the walls of the houses due to capillarity rise from the saturated soil.

Informal sewer networks are also problematic. Almost all of the households interviewed that are connected to such network (in six villages) mentioned that they have problems with frequent clogging of the sewers and subsequent need for maintenance work. Clogging occurs on average once a week. Some people in Hamamee mentioned that the network is not working for most of the time.

Problems faced by the population were assessed through Q8-9, Q21-22 and Q31-33 in the household survey questionnaire (Appendix 8).

Equipment of a villager responsible for the maintenance of the sewer network (Photo: L.Ulrich)

Situation in the "model village" of El Gharbawy (Beheira)

We visited the so-called "model village" of El Gharbawy (El Delengat district in Beheira governorate), 3'000 inhabitants, on 20th Jan 2011. Since 2002, the society of community development of the village has been executing a pioneering experiment in the field of village cleanliness and decoration, through an active engineer who has a strong belief that the civil community organizations have the ability to achieve developmental jump in the environmental system of villages in the case of support availability from the local authorities.

The social development society has undertaken awareness-raising and has implemented the following actions in the village:

- **Solid waste management**:
  1. Source separation, between organics, inorganics and dangerous waste (e.g. broken glass). The organic waste is collected every day and brought to a composting area. The compost is covered, mixed with dust and sometimes enriched with manure. It is sold for 10 EGP/m3. Inorganic waste is sorted and kept in a storage room until it is collected by a recycling company.
  2. Street cleanliness: baskets have been installed along the streets for rubbish collection and two labourers are mandated to make the village clean. 3 EGP/household/month are collected to pay the labourers.
- **Village beautification**: gardens have been created and the streets have been decorated and painted.
- **Manure source separation and reuse:** liquid manure is collected in a small separate tank and brought by the farmers to their fields, as it was done traditionally. The manure is supposed to have its maximal impact with vegetables.

What is more, most roads inside the village are paved and a health centre has been built.

Regarding sanitation, the villages still relies on the traditional bayaras. These bayaras are emptied about twice a month in winter and 3-4 times in summer. According to the interviewee, the difference is mainly due to the higher frequency of showers in summer. Besides, the groundwater level in the village is high, at about 1.5 m below surface, with water rising per capillarity in the house walls. The groundwater level is lower in winter, following the decrease of water level in the drains caused by the management strategy of Aswan dam.

The main weakness of the village is the absence of wastewater and sludge treatment. Septage from the bayaras is pumped by trucks and dumped in the nearest drain. As mentioned above, the bayaras need to be emptied quite often. The standard volume of the trucks' tank is 4 m3, and, as the volume of the bayaras is usually higher, 2 to 3 trips are necessary to empty a single one. Several trucks provide this service in the area, one of which is owned by the Development Society of the village (truck given by DANIDA), another by the Local Council of Missein (the mother village) and several other private operators. The prices range from 5-6 EGP/trip for the village truck, 8 EGP/trip for the truck of the Local Council and up to 15 EGP/trip for the private trucks according to the market.

In 2005, the village obtained an award for the best environmental work on the level of the Arab countries in the world environment day. Since then, the village became a model for other villages. In 2006, the practice started to spread in the neighbouring villages.

Ref: www.unhabitat.org/bp/bp.list.details.aspx?bp_id=874

5 Results of the sampling campaign

During the second and third sampling campaigns, in May-June 2013 and May-June 2014, 86 samples were collected from different types of sanitation-related flows: sewage, septage and liquid animal manure. The results of the analysis allow drawing some first conclusions about the characteristics of the different flows in small villages in the Nile delta. The comparison with the literature review shows the importance to have an updated data baseline and to collect first-hand data.

The uncertainty analysis shows the consistency of the results, with an uncertainty from 10 to 30%. On average an uncertainty of 10% can be assumed for NH_4, TP, TN and COD results and 20% for PO_4, NO_3 and NO_2.

5.1 Basic wastewater chemistry background

The wastewater characteristics have been evaluated by mostly three types of parameters: oxygen demand, nutrients and solids. Their importance is explained in Table 16.

Table 16: Important parameters in wastewater

Parameters	Relevance
Oxygen demand (BOD and COD)	Consisting mainly of proteins, carbohydrates, and fats, degradable organics are measured most commonly in terms of BOD (biochemical oxygen demand) and COD (chemical oxygen demand). BOD is part of COD and represents the organic fraction. If discharged untreated into the environment, the biological digestion of the organic matter can lead to the depletion of natural oxygen resources and to the development of septic conditions, as the anaerobic bacteria use the oxygen present in water. The ratio BOD:COD (always lower than 1) gives an idea of the degree of organic matter degradation. A ratio close to 1 shows that most of the organic matter still needs to be degraded; a lower ratio indicates a more biodegraded organic matter. It reflects also the potential for biogas production.
Suspended solids (TSS)	Suspended solids can lead to the development of sludge deposits in the sewer networks and anaerobic conditions when untreated wastewater is discharged in the aquatic environment.

Nutrients	Both nitrogen and phosphorus are essential nutrients for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land, they can also lead to the pollution of groundwater. The nutrients are mostly in dissolved form; the solid form is around 10% for nitrogen and can reach 40% for phosphorus. The dissolved form are: a) For nitrogen: organics, ammonia, nitrite and nitrate. The main source is human and animal excreta and is found in organic form. The organic form is transformed in ammonia through biological digestion. Then, in presence of oxygen, nitrification takes place, which transforms ammonia into nitrate (NO3) and then nitrite (NO2). Thus, the presence of nitrate and nitrite proves presence of oxygen. Usually, raw wastewater is anaerobic and most nitrogen is found in the form of ammonia. b) For phosphorus: poly-phosphate, ortho-phosphate and organics. Polyphosphates are present when soap/detergent contain phosphate, in which case it can represent the main phosphorus source and lead to serious problems of eutrophication in the water bodies if not treated. When phosphate-free soaps are used, the major source is ortho-phosphate (50-70%) coming essentially from urine. Nitrogen and phosphorus are the key-nutrients for reuse. Nitrate and orthophosphate are the forms that are most bioavailable to crops.

5.2 Sewage

5.2.1 Average concentrations

The average concentrations have been calculated for the five villages based on the morning sampling or the whole day sampling. Except for one village, the average concentration was always based on several samples.

The average results from both methods are shown in Table 17. The details can be found in Appendix 16.

Table 17: Average concentration measured in five villages

	Unit	**Hamamee*** 2012	**M. Nassar*** 2013	**K. a. Khalifa*** 2014	**K. a. Nuss**** 2013	**Fisha**** 2014				
Nb. of sample		1	3	9	16	10	**Average**	**Std.**	**Min.**	**Max.**
pH	-	6.9	7.7	8.3	7.2	8.3	**7.7**	*0.6*	6.9	8.3
DO	mg/L			0.52	0.54	1.34	**0.80**	*0.38*	0.52	1.34
Cond.	mS/cm		1.3	3.3	2.4	2.9	**2.4**	*0.8*	1.3	3.3
Temp	°C			24.0		23.7	**23.9**	*0.1*	23.7	24.0
BOD	mg/L		548	916	391	507	**591**	*197*	391	916
COD	mg/L	1075	788	1499	614	1294	**1054**	*323*	614	1499
TS	mg/L	1036	1221	2804	1282	1620	**1593**	*634*	1036	2804
TSS	mg/L	245	172	380		320	**279**	*78*	172	380
NO2-N	mg/L		0.037	0.462		0.049	**0.183**	*0.198*	0.037	0.462
NO3-N	mg/L		0.4			2.3	**1.4**	*1.0*	0.4	2.3
NH4-N	mg/L	109	42	174		170	**124**	*54*	42	174
TN	mg/L	212	110	218	113	234	**177**	*55*	110	234
PO4-P	mg/L		5.7	4.0		5.0	**4.9**	*0.7*	4.0	5.7
TP	mg/L	6.4	6.9	14.1	10.0	10.7	**9.6**	*2.8*	6.4	14.1

* Morning sampling (08:00-13:00)

** Full day sampling

For all villages, the wastewater can be considered as high strength.

Significant differences are observed between villages, which are caused by different factors like the water consumption, the number of cattle, the discharge place of the liquid animal manure or the discharge place of greywater. The impact of each of these factors are more precisely discussed in the MFA report.

The concentrations and ratios (Table 18) indicate that the sewage is anaerobic with a biodegradability potential which is still high (BOD:COD = 58%). The high PO4:TP ratio shows that soap used in the area does not contain polyphosphate (see §5.1). Besides, this sewage presents a low TSS amount. COD, BOD and ammonium concentration were compared with Egyptian literature data and show similar results.

Table 18 Different ratios in sewage. *(in brackets, the standard deviation)*

	TN:TP	**BOD:COD**	**TSS:TS**	**NH$_4$:TN**	**PO$_4$:TP**
AVG	**19.5** (7.6)	**58%** (11%)	**18%** (4%)	**60%** (16%)	**53%**(23%)

Different problems occurred during the sampling campaigns: analysis problems during the first sampling campaign, clogging events or drinking water shortage leading to a really low wastewater flow, and the unclogging of a sewer during a sampling event. As a consequence, several sample results needed to be deleted and removed from the analysis.

5.2.2 Daily flow variation

Figure 8 shows the flow variation measured at the outlet in Fisha and Kawm an Nuss with the help of the self-constructed flow meter. Only the two most representative days are presented. In Kawm an Nuss, the sewer network collected the wastewater produced by around 3,000 inhabitants, and in Fisha by around 250 inhabitants.

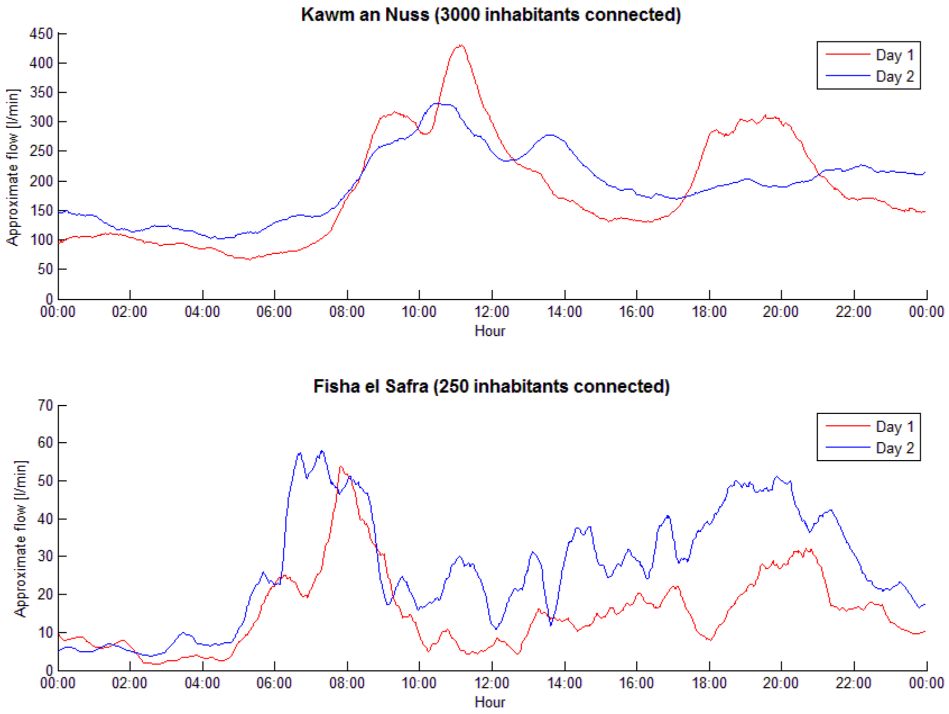


Figure 8: Daily sewage flow variation, with one average value per 45 min

There are two flow peaks, the first one during the morning, the second during the evening. The morning peak occurs between 8 am and noon in Kawm an Nuss and between 6 am and 10 am in Fisha. This difference could not be explained, even if the length of the pipe in Kawm an Nuss (1.6 km) might have an impact. The evening peak is lower and more spread, and is probably caused mainly by showering.

There is a significant difference depending on the number of people connected to the network. The higher the number of people connected, the smoother the flow line. When the number of inhabitants is lower, the effect of individual events is more important.

The flow between 2 am and 5 am is usually used to estimate the groundwater infiltration in the network because hardly any human activity takes place at that time. In Kawm an Nuss, this residual flow represents 36% of the average flow, which is a really high amount. The network is linked to the drain through a 10-year old pipe passing under agricultural land on a distance of 1.6 km and at a maximal depth of 3 m, where the groundwater table varies from 20 cm to 3 m. In the second village the pipe is much shorter (~100 m), and the infiltration rate reaches 11%.

5.2.3 Impact of clogging

Clogging occurs often (see §4.8) and can have a considerable impact on the daily flow variation. Figure 9 shows an example of the impact of a clogging and unclogging event on the wastewater flow at the outlet in Fisha. The pipe got clogged around noon leading to no significant wastewater flow at the outlet during all the afternoon and evening (no evening peak). The unclogging event, appearing here shortly after 8 pm, leads to a peak in the flow and in the concentrations, as shown in Table 19.

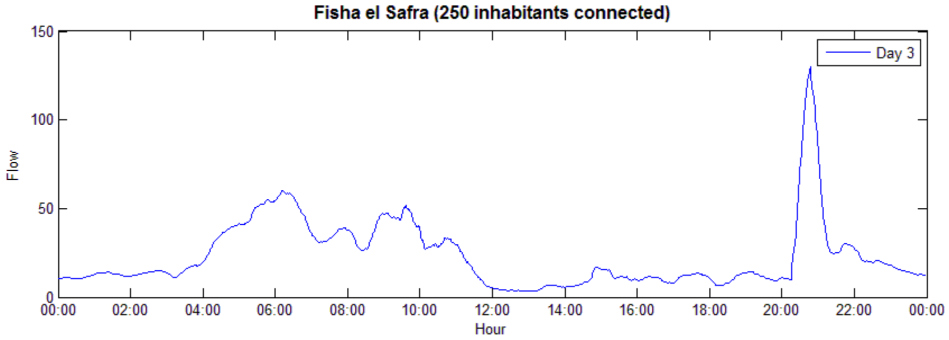


Figure 9: Daily flow variation in Fisha el Safra during clogging, with the unclogging event at 9pm

Table 19: Average concentrations measured during the unclogging event

Nb of sample	**2**
pH **DO** **Cond.**	**7.3** **0.6** **3.2**
BOD **COD**	**987** **1601**
TS **TSS** **TDS**	**3116** **870** **2110**
NH4-N **TN**	**<111** **196**
PO4-P **TP**	**12.9** **15.0**

The uncertainty of the flow measurements and the obviously high infiltration rates make the calculation of peak factors not possible at that stage. More samples are needed.

5.2.4 Daily variations of loads and concentrations

When doing a 24-hour sampling campaign, the average concentration of the different parameters should be calculated by weighting with the respective flow at the time of sampling. It also allows to calculate when and what are the characteristics of the peak flows.

The average and maximum measured concentrations measured during the 24-hour sampling in Kawm an Nuss are provided in Table 20.

Table 20: Results of one-day sewage sampling – Kawm an Nuss (16 samples)

		Weighted Average	Max.	Nb.
Flow	l/min	**178**	228	16
BOD	mg/l	**390.8**	620	16
COD	mg/l	**614.3**	948	16
TS	mg/l	**1282.4**	2100	16
TN	mg/l	**112.7**	206	15
TP	mg/l	**10.0**	14.0	16

In order to compare the variation of the different parameters, Figure 10 shows a graph with normalised concentrations. The normalisation is done using the formula

$z = \frac{X - \mu}{\sigma}$, where the value minus the average is divided by the standard deviation.

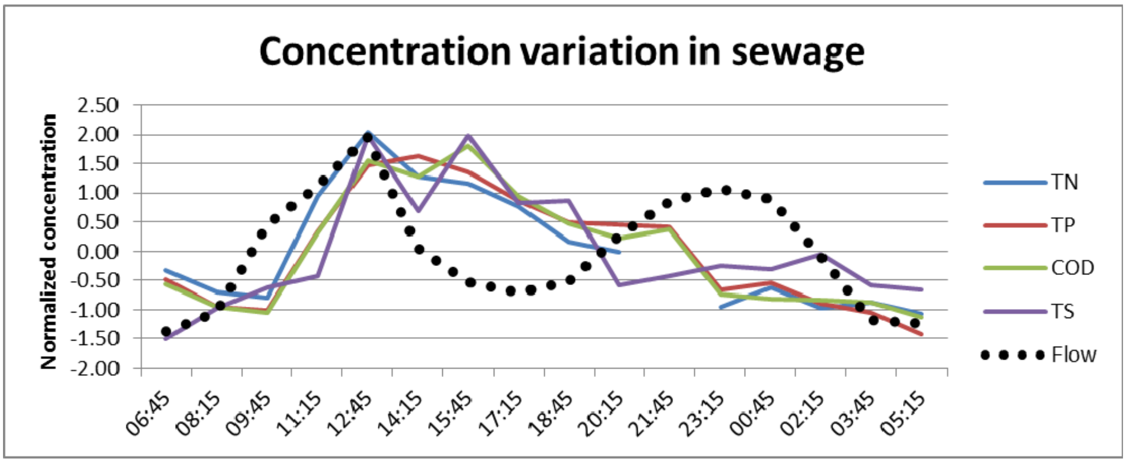


Figure 10: Daily concentrations and flow variations in sewage – normalized values - Kawm an Nuss

In the morning, both the concentrations and the flow increase gradually when people start their activity. A nitrogen and solids peak concentration is observed around noon. Midday is a critical time as it features both the peaks of the different concentrations and of the flow. After that, the flow decrease drastically but the concentration of different pollutants remain high, probably because of the frequent use of toilets. The second peak flow corresponds to lower concentrations, which may indicate that it consists mainly of greywater from showering. Indeed, a higher proportion of greywater in the flow means lower loads.

Between 3 and 6 am, the flow is constant and is mainly due to infiltration and drinking water leakages. The concentrations slightly decrease. Residual concentrations can be caused by the groundwater and transport of organic matter accumulated in the sewer network.

The representativeness of the morning composite sample (see §5.2.1) is evaluated by comparing the average concentration from 8 am to 1 pm to the daily concentration. The whole day sampling shows that the 5-hour morning composite sampling tends to overestimate nitrogen (15%) due to its high peak occurring the morning and, on the other hand, the phosphorus, the total solid and the chemical oxygen demand is slightly underestimated (5%). However, it does not allow to observe the peak flow which is one of the most important parameters to size a treatment plant.

5.3 Septage

12 samples of septage were analysed. All of them were taken during the second sampling campaign, from March to May 2013. The average concentration measured is given in Table 21 and Table 22. The detailed results can be found in Appendix 17.

Table 21: Results of septage analysis, 12 samples

		Average (Std.)	**Max.**	**Nb.**
pH	-	**7.8** (0.3)	8.2	12
DO	mg/l	**0.14** (0.02)	0.18	7
Cond.	mS/cm	**4.56** (2.43)	8.62	8
BOD	mg/l	**2'017** (1'864)	5'800	9
COD	mg/l	**5'703** (5'556)	15'225	10
TS	mg/l	**7'278** (9'778)	28'400	12
TSS	mg/l	**1'252** (1'336)	3'900	12
NO2-N	mg/l	**0.03** (0.05)	0.13	8
NO3-N	mg/l	**2.11** (1.57)	4.07	8
NH4-N	mg/l	**262** (214)	735	12
TN	mg/l	**415** (343)	1290	12
PO4-P	mg/l	**11.6** (7.4)	20.9	8
TP	mg/l	**41** (43.7)	159	12

Table 22: Different ratios in septage *(in brackets, the standard deviation)*

	TN:TP	BOD:COD	TSS:TS	NH_4:TN	PO_4:TP
AVG	**12.3** (2.5)	**48%** (16%)	**26%** (17%)	**65%** (21%)	**41%** (37%)

Septage has by and large a much higher concentration as what is found in sewage. This can be explained by:

- A lower water consumption by the inhabitants having on-site sanitation systems, who tend to minimise their consumption in order to reduce the emptying frequency-
- The different composition of the septage: the survey have shown that approximately half of the greywater produced by bayara owners is discharged directly in the environment and thus do not contribute to dilute septage; thus, bayara content consists mainly of blackwater
- Sometimes, exfiltration of water into the ground, with the solids staying in the bayara.
- Biological activity in the bayara, which does hardly happen in a sewer system.

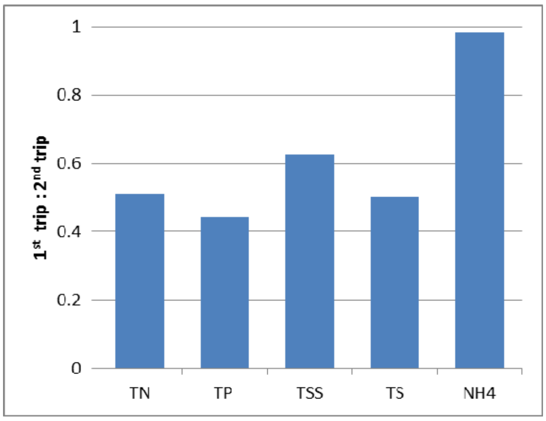
There is a high variability among samples: some have characteristics comparable to sewage, other have very high concentrations with up to four times the average concentration observed in septage (example for TS, which has an average of 7’278, a standard deviation of 9800 and a maximum value of 28’400 mg/L - see Table 21).

The variation between samples could not be explained clearly: correlations were searched between the different concentrations, ratios and physical characteristics of the bayara, which did not lead to convincing explanations. Nevertheless the three following factors clearly play an important role on measured concentration:

1. The **way of emptying** brings a high variability in the sample characteristics. The septage inside the bayaras is not homogeneous, but structured in different layers, the most important of which are the sludge, the settled liquid and the scum. The lower part is more concentrated than the upper one due to settling. Thus, the depth to which septage is pumped plays an important role.

   During the sampling campaign, the septage sampled from two trips from the same bayaras was analysed. The first trip represents the concentrations in the upper layer of the bayara; the second one contains more solids and part of the settled sludge. The ratio between both results shows concentrations twice higher in the bottom layer, except for ammonium which is soluble and with a homogenous concentration in the entire tank (Figure 11).

Figure 11: Concentration ratios between the first and second emptying event of the same bayara



2. The **residence time**, which depends on the water consumption, and the size of the bayara can have a significant influence. The analyses show concentrations 3 to 6 times lower in samples taken from bigger bayara (8 m^3 and more) as from smaller one (4 m^3 and less). Indeed, in bigger bayara, the trucks tend to pump only the upper part, complete emptying occurs less often and sludge accumulates at the bottom. At the same time, the residence time of wastewater is increased, which favours biodegradation and the settling process.

   Biodegradation increases with the wastewater residence time. Organic matter is degraded and biological oxygen demand (BOD) reduced. This results in a higher COD:BOD ratio in septage (50%) than in sewage, (70%) which indicate a lower biodegradability of septage.

   The high difference in PO4:TP ratio shows that bayaras do not contain the different forms of phosphate in the same proportions.

3. **The interaction with groundwater**: In some case groundwater infiltrates in the bayara and dilutes the septage. In some other case seepage into the ground occurs and tends to concentrate the septage. This depends on the type of bayaras (sealed/un-sealed), the groundwater table and the average septage level in the bayaras.

A sample coming from the bayara of a mosque in Hadery was analysed (Table 23). It shows some really diluted wastewater with concentrations 4 to 14 times lower than the average. This can be explained by the fact that this septage consists mainly of greywater (from ablutions) and little organic matter. The TN:TP ratio (17) is higher than the average observed (10.5), which is probably caused by an higher urine proportion in the black water.

Table 23: Characteristics of septage coming from a mosque (Hadery, 1 sample)

	TN [mg/L]	TP [mg/L]	COD [mg/L]	BOD [mg/L]	TSS [mg/L]	TS [mg/L]
Mosque	107	6	375	182	138	1400
Average septage	**415**	**39.5**	**5149**	**2017**	**1252**	**7278**

5.4 Animal liquid manure

12 samples of liquid animal manure were taken and analysed. The average results can be found in Table 24 and Table 25, and the more detailed ones in Appendix 18.

Table 24: Result sampling liquid manure, 12 samples

	Unit	Average (Std)	Max.	Nb.
pH	-	**8.9** (0.2)	9.1	8
DO	mg/l	**0.23** (0.22)	0.72	8
Cond.	mS/cm	**40.06** (4.01)	45.5	8
BOD	mg/l	**9'173** (3'527)	13'800	12
COD	mg/l	**16'041** (3'691)	22'320	12
TS	mg/l	**34'642** (5'730)	43'160	12
TSS	mg/l	**5'913** (2'395)	11'200	12
NO2-N	mg/l	**0.34** (0.36)	0.94	8
NO3-N	mg/l	**5.43** (2.67)	9.31	4
NH4-N	mg/l	**1'657** (1'228)	3425	9
TN	mg/l	**2'988** (1'256)	4385	10
PO4-P	mg/l	**2.8** (1.4)	4.3	7
TP	mg/l	**27** (13)	51	12

Table 25: Different ratios in liquid manure (in brackets, the standard deviation)

	TN:TP	BOD:COD	TSS:TS	NH_4:TN	PO_4:TP
AVG	**119.6** (77)	**58%** (14%)	**17%** (6%)	**52%** (27%)	**12%** (9%)

The liquid animal manure is characterised by a really high load of nitrogen oxygen demand and total solids. By comparison, the phosphorus load is low, which leads to a high TN:TP ratio (119.6). Depending on the number of cattle and the proportion of manure discharged into the sanitation system, the loads due to manure can be considerable (see *ESRISS Material Flow Analysis* Report). The high concentrations of solids may contribute to create blockages in the sewers.

This high load of nutrient makes it an ideal target for resource recovery.

6 Lessons learnt & recommendations

This extensive study leads to lessons learnt and recommendation at different levels: experience for field work, insights on how to complete the data baseline and, last but not least, recommendations for the national rural sanitation strategy.

6.1 Field work

The literature review showed a big lack of materials about rural sanitation in the Nile delta. This gap pushed the ESRISS team to create its own first-hand data baseline, which is a pretty long and hard process. The experience showed how difficult it is to get consistent results in such an environment.

Field work led to the following lessons learnt:

- **Sampling**:
  - Sewage: composite samples give a better average concentration but have an uncertainty due to a longer storage and increase in dissolved oxygen content, which is accelerated by the addition of each new subsample. Next to that, situation such as clogging in part of a network may bias the results at the village level.
  - Septage: each sample should be linked with the bayara characteristics and the emptying process; in an ideal case, bayara emptiers should be accompanied and their activity observed (number of emptying in the same bayara, depth of the pipe when emptying); this would allow to make better sense of the high variability of the results.
  - Liquid animal manure: sampling have to be done early in the morning, before the collection holes are emptied, which sometimes occurs before 7:30 am.
- **The representativeness of the samples** is one of the major challenges: the sampling methodology as well as the sampling time are overly important. The one-day sampling campaign has shown the variability of wastewater quantities and characteristics during the day. Representativeness is also a challenge with the surveys and interviews; great care has to be taken that the whole population is represented, and not only relatives of the village leaders.
- The **storage of samples** is important in order not to influence the sample characteristics. The sample has to be cooled down to 4°C as fast as possible; therefore a big icebox is needed with a consequent amount of ice
- The **lab precision**: a high uncertainty within the labs and a high variation between labs have been observed; in other words, cross-checking is necessary and results should not be trusted at once. Make sure of what the Affiliated Company labs can or cannot analyse.
- **Units**: sometimes, different labs and different studies do not use the same units, which can lead to confusion. Care should especially be taken with

nutrients, which can be measured in many different ways: TN, TKN, NO3, NO3-N, for example for nitrogen; PO4/PO4-P for example for phosphorus.

- **Trustworthiness of the answers** from surveys and interviews: the answers should always be taken with care and cross-checked. Two main factors lead to uncertainty: (a) in the local culture, people often tend to give an answer even if they do not know; (b) the visit of a team raise expectations and some people may tend to give an answer which they think will serve their interests. Next to that, it should be always beard in mind that people may be inaccurate or inconsistent in their answers during interviews. Thus results from the surveys should be critically assessed and revised based on personal observations.
- People have difficulties to give **quantitative estimations**
- **Careful planning**: sampling of septage especially needs to be arranged in advance with bayara emptiers, since they usually work in more than one village and there is not one single disposal site of the septage

6.2 Further developments of the data baseline

The baseline data would greatly benefit from further sewage and septage sample analyses in ezbas. Further sampling campaigns should be organised, in more villages, but also on a more extensive period of time. Samples should be taken over the whole year to characterise seasonal variations, and through the whole day to characterise daily variations and peaks (so far, only one 24-hour sampling). It is also important to better estimate the infiltration of groundwater into the sewer network, as it seems to be very significant. As for septage, our results show a very high variability, which makes an evaluation of the characteristics at a village-level still difficult. There is a need to quantify the factors influencing septage quantities and characteristics.

In general, flow measurements are observed to be a major shortcoming in Egypt, and any new wastewater infrastructure would greatly benefit from close inflow monitoring; this in turn would help to better design further treatment plants. Any project should be systematically documented and monitored, in order to generate lessons learnt and reliable data; this is currently hardly the case.

The field studies show a high heterogeneity among villages, which means that, for any new project, a site-specific preliminary assessment is necessary (see also the report "*Challenges and Ways Forward*"). The report "*Material Flow Analysis*" details which parameters should be collected on a site-specific basis.

Accuracy and representativeness of the data is a major issue. To deal with it, it is necessary to apply different methods in order to cross-check the data collected. It goes from asking a same point through different angles in an interview, to send the same samples to different labs or to bring control standards.

Finally, in order to get a full data baseline for rural sanitation in the whole country, it is recommended to replicate the field studies in Upper Egypt, where the situation is different. This would lay a strong basis for the development of national policies and guidelines.

6.3 Recommendations for the national rural sanitation strategy

- **Taking into account the high variability of the small settlements**

  This study reveals the high heterogeneity of the small settlements in the Nile delta. These differences in density, shape, proximity to drains or canals, groundwater table, quality of the water supply, number of animals per household have an impact on how the sanitation system should be designed and which options are more cost-effective. In particular, these factors have a strong influence on the quantities and characteristics of the wastewater to be treated and on the cost of the sewer system per capita. Thus, it is recommended to have a case-by-case approach for planning and selection of appropriate technologies.

  The skills, capacities and willingness to participate differ also significantly from one village to the other. The key village sanitation stakeholders should be involved in the process from the start. It is highly recommended that the future management scheme be discussed and validated before the final selection of technical options.

  The sampling campaigns have shown the high variability of wastewater quantities and characteristics at that scale. Rural wastewater is clearly more concentrated than urban wastewater, which should be taken into account for future designs. Regarding septage from the bayaras, it is five to ten times more concentrated than the average sewage from such villages. The analysis of the current practices highlights the factors causing this high variability. One of the main reasons is that the villagers who rely on on-site sanitation systems tend to minimise their water consumption in order to reduce the emptying frequency, and thus the costs.

- **Cost of water and sanitation services**

  The costs currently born by the inhabitants of the villages under investigation for drinking water and sanitation are highly variable. The villagers relying on traditional bayaras have to pay very high costs, sometimes 20 times more than those served by governmental sewer systems. On the contrary, the amount paid for wastewater services from the water bills is insignificant. It shows a high inequality between served and unserved areas.

  Many communities decided to gather the amount of money to construct a basic “informal” sewer system in order to eliminate the burden of the bayaras (high emptying frequency, high costs, limitation of water consumption). The data show that the investment is offset only in a few months to about three years, depending on the village situation. Unfortunately, the lack of technical expertise often turn these constructive initiatives into the source of further problems. If villagers would build proper shallow sewer systems, the price would certainly be higher. However, on the medium term, in most cases, it would still certainly be more cost-effective than keeping the bayaras. Case-by-case financial comparisons should be made in order to encourage villagers to invest. If the investment costs are too high to be paid at once, leasing mechanisms could be thought of, with monthly payments that are inferior with the amount currently paid for bayara emptying.

  Regarding the price of drinking water, the results show that, with an average between 0.7 and 1 EGP/m3, the villagers pay significantly more than the official tariff. It also shows that, in general, the water bills are not directly linked to the building consumption. It is recommended to cross-check regularly water readings from a few water meters with the respective water bills and what is finally counted at the level of the Affiliated Company. On the positive side, it shows that people are actually ready to pay more than the official tariff.

Our study shows that there are no reliable statistics and no reliable numbers regarding critical factors such as the population number and the water consumption. Only water meter readings over a period of at least one month (including at least three readings per meter) can provide a realistic estimation of the latter. It cannot be based on the price paid by the household for water, as the water bills are very often not directly linked to the building consumption.

- **Septage management**

  The emptying of bayaras is done mechanically by trucks, which transport and discharge the septage in the nearest drain. Although Village Councils usually own one truck, the majority of them are privately owned. Bayara emptying is thus mainly an informal private business, which seems to be a rather good business. A cost-effective way to reduce contamination loads in water bodies would be to build proper septage disposal points, including a primary treatment unit. The private service providers could pay a small fee for each discharge, which would cover the small O&M costs.

- **Building upon the people's interest for fertiliser materials**

  There is a strong interest in organic fertilisers: sludge, manure and compost. It highlights a need of the Egyptian farmers. The selection of sanitation systems should be geared towards the production of good quality fertiliser material and the conservation of nutrients. Small scale systems are particularly fit to this aim, as the sludge in small settlements is not contaminated by industrial activities and the product can be reused on-site by the villagers themselves. It is thus important to produce a well stabilised sludge and foster the production of good quality compost at farm level.

  It is recommended to organise a collection service at village level for the liquid manure, which could be mixed with organic waste in a compost trench or stored in a tank to enable mechanical transport to the fields at the appropriate time. Such a service could be coupled with solid waste collection and/or maintenance of the sewer system(s). This would lead to the establishment of integrated environmental service providers. Solid waste collection services and sewer maintenance services already exists in numerous villages.

  If possible, the treated effluent should be reused directly for irrigation, without transiting through a contaminated drain. The construction of a small pond as a polishing step, from which farmers can directly pump, is recommended. Where aquaculture ponds exist, they should be used as a final polishing step.

- **Building upon the private initiatives**

  It is recommended to take advantage of the existing private initiatives to support and improve them. The decision taken in 2012 by HCWW under the auspices of HE Minister Abdel Kawi Khalifa to provide technical support to the communities willing to pay for a sewer system should be further extended. Where people still rely on on-site sanitation systems, the Government can build upon the well-developed private bayara emptying business in order to improve the existing practices and provide proper disposal points.

- **Adapting Law 48/1982**

  The law 48/1982 should be revised as a prerequisite for sound rural wastewater treatment and investment. The stringent regulations “kill” simple but robust solutions and induce complex and costly options that do not work on the long term (O&M, recurrent investment costs, energy, availability of the necessary skills). The main limiting factor in this law is the COD value (80 mg/L), which is even significantly lower than the standard in the European Union (125 mg/L). The dissolved oxygen level (> 4 mg/L) is also a major limiting factor, as it forces the implementation of a costly aerobic treatment step.

  The Egyptian authorities should inspire themselves from the countries in the region which are more advanced in terms of water and wastewater management, such as Jordan and Morocco. Both countries have much more pragmatic standards (250 mg/L COD in Morocco; 300 mg/L COD for biological treatment in Jordan). Morocco is implementing an incremental approach for the implementation of the standards. Such an incremental approach is certainly the way to go for the rural areas in Egypt.

ESRISS field sampling and analyses, Beheira Governorate

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APPENDIX 1: Villages visited during the first selection phase in 2011

Village	Popul.	Mother Village	Key Characteristics	Comments
MARKAZ DAMANHUR				
El Daramelly	1'245	Zawyet Ghazal	- Sewer network (1 year old), self-installed & financed - No SWM, no CDA	Mr Said, head of the village council, is helpful and informed.
Zawyet Ghazal	1'559	Zawyet Ghazal	- Informal sewer network - Collection of SW by municipality truck - No CDA	Will for a new sewer by inhabitants
Ebrahim Masood	2'174	Zawyet Ghazal	- Sewer network (3years old), self-installed & financed - No SWM, no CDA	
Kabeel	1'762	Zawyet Ghazal	- Sewer network, self-installed - No SWM, no CDA	- *Omda* motivated, ready to give land for a plant - Will for plant by inhabitants
El Shoka	2'923	Al Abahadeya	- Sewer network, self-installed & maintained - Covered drains within ezba - Burning of SW - Very high groundwater level	- Intense problems – frequent flooding and smells - Ongoing works by the village council – coverage of a second drain
Sontais	4'414	Desones	- Sewer network - Disposal to covered drains - Good SWM - recycling	- Problems with flooding - Relatively wealthy village
El Haganeya	4'697	Desones	- On-site sanitation- bayaras - Emptying by CDA trucks (2-3 times/week, 10 LE/empt.) - Separate collection of rainwater - High groundwater level - Collection of SW	- Problems with flooding - Well-functioning CDA - Clean and tidy village
El Seru	1'082	Desones	- On-site sanitation- bayaras - Greywater on streets - evaporation	Not apparent problems so far
MARKAZ ABU HOMMUS				
El Karawy	2'864	Abu Hommus	- Sewer network and WWTP - Financed by one person - No SWM – CDA existent	- Ongoing project of NOPWASD for new sewers & connection to cluster despite existing WWTP
Abu Kbaria	2'556	Besentway	- On-site sanitation-*bayaras* (Once a week, 7-60 LE/empt) - CDA with social role, no SWM	- Main problem lack of enough trucks & small capacity of them - Besentway village council helpful and well-informed
El Ashara	2'252	Besentway	- On-site-*bayaras* (every 2days to once a week, 20LE/truck) - Stormwater on the streets - CDA with social role	- Main problem lack of enough trucks & small capacity of them - Bad smell of drinking water - People worried & friendly
El Hamamee	730	Dmesna	- Informal sewer network - No CDA, no SWM, no *omda*	- Small and very dense village - Intense problems with flooding - People worried and willing to pay for part of the sewer network

MARKAZ EL MAHMUDEYA				
Kafr Nekla	2’532	Ariammon	- Informal sewer network (3-4 years) - Collection of SW by municipality truck - No CDA	- Municipality of Ariammon sounds very active - Director of Ariammon WWTP informed and respected in ezbas
El Kashlan	463	Ariammon	- On-site sanitation- *bayaras* - Emptying frequency varies according to household activities - Collection of SW by municipality truck - No CDA	- No particular problems so far - Very small ezba
Taameya	937	Koum El Nasr	- Informal sewer network (3-4 yr), self-financed - No CDA, no SWM	- Clogging, flooding, need for cleaning of pipes twice a month - Locals not very interested
Sawaby	360	Koum El Nasr	- Informal sewer network (~1.5yr) - Very high groundwater level - CDA with social role	- No taps in the houses - New network, no problems
Zezenia	1’200 +369	Koum El Nasr	- Informal sewer network & a small part of the village with *bayaras*	- No organization, no coherence in the community, problems mainly due to people not collaborating
MARKAZ SHOUBRAKHEET				
Robdan	2’681	Robdan	- Sewer network (3-4 years), self-installed - Milk & brick factories - CDA and SWM (collection)	- Good collaboration of CDA and municipality authority - Vivid interest for a WWTP, although no serious problems
Abu Dora	4’818	Lakana	- Sewer network (12 years old), self-installed & financed - Very high groundwater level - Bad quality of drinking water - No SWM - CDA – not very active so far	- Poor design of sewers, a lot of flooding, diseases - Vivid interest for a solution - *Omda* very interested and helpful
MARKAZ ETAY EL BAROOD				
Houd Fares	838	El Nebira	- Plastic sewers (10 years old), self-installed & financed - Discharge in a nearby pond used for irrigation - Very high groundwater level - No SWM, no active CDA	- Not so easy access to village - Leader of the village (*sheikh al balad*) friendly but not very helpful
El Nokrash El Gedida	1’482	El Nokrash	- Plastic sewers - Discharge in a nearby pond - Very high groundwater level - No SWM, no active CDA - Manure not allowed in sewers	- Frequent failure of pipes and regular cleaning - Not so easy access to village - *Omda* rather indifferent
Omran	1’504	Saft El Hageya	- Plastic sewers - Very high groundwater level - Burning of SW - No CDA	- No kind of community organisation – everyone responsible for his own home

APPENDIX 2: Field notes from the first village selection phase

Team members: Philippe Reymond, Anastasia Papangelou, Lukas Ulrich and Mohamed Hassan Tawfik

Logistical support by: BWADC

Mission 19-21 November 2011

El Hamamee (Dmesna)

Date: 19.11.2011

Interviewed: Omda Abd El Rahman Maayun and locals

General characteristics

El Hamamee is a small, dense village belonging to the *omodeya* of Dmesna, with a population of 730 inhabitants, according to BWADC data for 2006. *Omodeya* of Dmesna comprises of 5 villages and hamlets, with a total population of more than 7'000 inhabitants. El Hamamee is considered to be a recent village and its inhabitants are all workers in the land of the *omda.* That means that they do not own land themselves and they are therefore poorer than people in neighbouring villages. This is also the reason why most inhabitants do not own many animals and the milk collected is sent outside of the village for processing.

There is a health center in Dmesna, but no CDA or other NGO in El Hamamee, neither some kind of leader in the hamlet; people address directly to the *omda* for any problems they may face.

Sanitation

Although Dmesna still relies on on-site sanitation, El Hamamee is served by an informal sewer network for about 10 years now. The network discharges to El Hamamee drain, right outside the village, which subsequently flows into an agricultural drain 1 km away. Problems occur from time to time, probably due to solid wastes disposed in the pipes.

Three years ago, a project by the Government was launched to connect all 5 villages of the *omodeya* to a WWTP. Indeed, the networks were installed in Marium and Dmesna, but the WWTP was never constructed, even though the omda offered land for this reason. It seems that this project was related to NDP party. Concerning El Hamamee alone, we were told that there is a plan to pump the wastewater to a new WWTP in Berkit Khatas, 8 km away.

Solid waste is collected with a truck and brought to a place called Sawali. People pay a fee of 10-15 EGP/month for this service. *Omda* stated that the village council has no decision-making power, but everything comes top-down from Cairo.

Drinking Water

Drinking water supply was described to be good, both in quality and quantity, apart from some occasional problems with low pressure. *Omda* estimated that 99% of the household have their own water meters. The community deals with BWADC only for drinking water related issues.

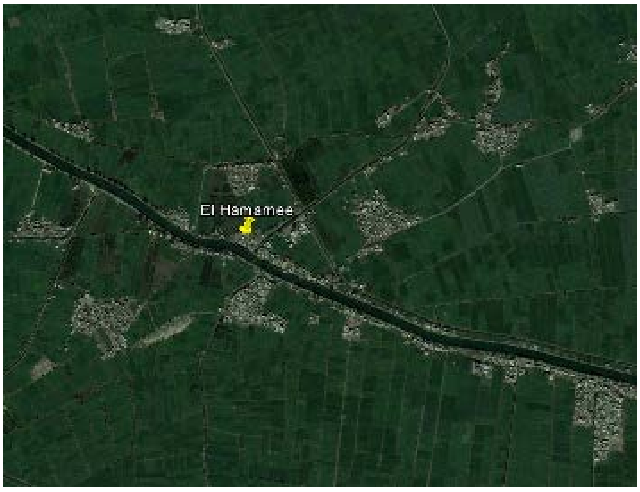

Figure 1 Satellite image of El Hamamee

El Ashara

Date: 19.11.2011

Interviewed: Sheikh Mohsen Saad

General characteristics

El Ashara is a hamlet of Besentway village with a population of 2'252 inhabitants (BWADC data for 2006). The sheikh estimated that there are 370 houses in the village, each occupied by 35-40 people. It seems that each household comprises of 7-10 people. The vast majority of inhabitants are farmers. There are no industrial activities and the milk collected is sold raw outside of the village.

In El Ashara there is one health center and two NGOs. One of them provides relief to the poor, by distributing charity money, and the other one is an agricultural association helping with matters such as fertilizer purchasing. The latter also built the two schools in the village. Responsible for both of them is the sheikh himself and seems like there is no other leader of any kind in the community.

Sanitation

Houses are served by on-site sanitation facilities (*bayara* or *birr*). Bayaras look big and they are made out of brick, with lining and salt added to avoid compaction of the sludge. The need for desludging varies with season (more frequent during summer), but on average, bayaras need to be emptied every 15-30 days. There are 6 private emptying trucks in the village. The size of the bayara depends on the size of the household, and sometimes 3-4 trips are needed to empty one pit, for a price of 20 L.E./trip. The sludge from the on-site facilities is disposed to *Muzlaf Abu Ruslan* drain, 400 m away from the village. Overflowing of bayaras may happen when the truck cannot come early enough to empty it.

Liquid part of manure is drained separately and collected in a special tank outside the stable. From there, women empty it to the drain 1-2 times a day, according to the number of animals.

There was a will from part of the population to build a sewer system, but it was not realised because too many people could not afford it. The village is anyway close to Besentway WWTP (5 km) and will probably be connected to it one day. The WWTP, based on a Kruger system (extended aeration) is designed for 10'000 m^3, but currently only receives 1'000 m^3.

Drinking water

All households are connected to the drinking water system, but experience problems with low pressure during the day. Some households have motors to help them increase the pressure.

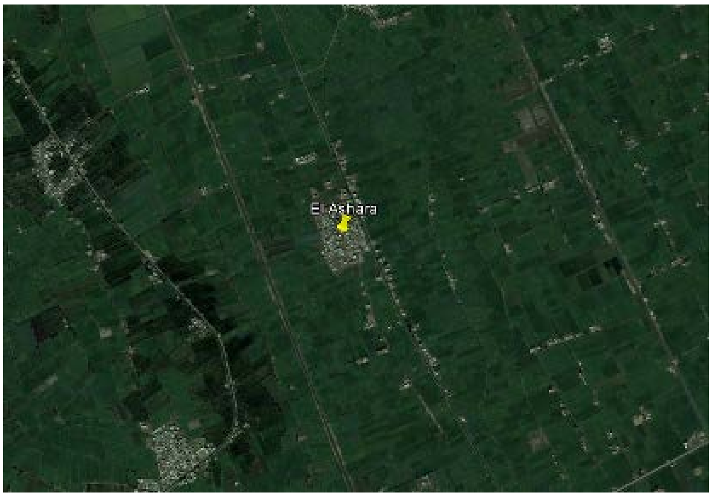

Figure 2 Satellite image of El Ashara (GoogleEarth)

Abu Dora

Date: 20.11.2011

Interviewed: Omda Ala Gourab, his brother and Mr Mousaad (sewer operator)

General characteristics

Abu Dora counts 7’000 inhabitants according to *omda* (4’818 from BWADC database) and it is the centre of omodeya of Abu Dora. Most roads are asphalted and the village looks ok, except the water (or wastewater) spilled on the street and open spaces. A high percentage of the population works on the North Coast and they are better-off than the rest of the inhabitants, who are farmers. There are no industrial activities and only one CDA with religious activities is currently active in Abu Dora.

Sanitation

The inhabitants constructed an informal sewer network, which resembles a shallow-sewer system. However, due to bad design and construction (thin plastic pipes), it may actually be rather a small-bore sewer system: depth is said to be between 1.2 and 2 meters, diameter between 8 and 14 inches. In any case, the network is facing a lot of problems, with frequent overflows and need for permanent unclogging by the sewer operator.

Originally, the main sewer was supposed to discharge the water to Bishara drain, 2 km away from the village. However, the main is currently out of order and the water is discharged in an agricultural drain bordering the village.

A small part of the village (about 50 houses) is not connected to the network: villagers are unwilling to connect due to the problems it causes. Instead, they rely on bayaras (about 2-3 meter deep, constructed with bricks with lining at the bottom and addition of salt to avoid clogging). The bayaras have to be emptied every week to ten days and every bayara needs one to two trips to be emptied.

The cost amounts to 10-15 L.E./trip. The emptying is done by private trucks, owned by people from outside the village. It seems that they discharge in the Bishara drain, 2 km away.

There is a WWTP at about 500 meters of Abu Dora, supposed to serve the neighbouring mother village, Lakana. Finished in 1996, it never worked until now, according to BWADC. It was constructed by NOPWASD and owned by the Village Council and it was supposed to be transferred to BWADC, however, there is a Court case about the responsibility of this disaster; the consultant asks for 8 mios EGP for rehabilitation. As a consequence, BWADC thinks of transforming it into a pumping station and derive the wastewater to a new WWTP in Sharnoub. It is also not clear why Abu Dora has not been connected to that plant, as it is actually closer to it than Lakana - probably the result of NOPWASD random planning.

Regarding manure handling, different practices were mentioned, with some villagers disposing it in the sewer network and others to a separate drain.

We were also told that a solid waste management project started before the revolution but stopped during it and it is supposed to start again sometime.

Drinking water

People in the village mistrust drinking water from the network, as a doctor (Dr. Moustafa Nakhas) said that it is contaminated. It is indeed highly probable that cross-contamination occurs with the wastewater sewer network; water pressure is often low, especially in summer, and some people use motors to increase pressure. It seems that all households have water meters and each household pays 5-6 EGP/month for drinking water supply.

Comment from the sewer operator: it seems that 90 % of people have liver problems.

El Haganeya

Date: 21.11.2011

Interviewed: Ahmed Harby, head of the village council and members of the CDA

General characteristics

El Haganeya is a big and quite tidy village and also one of the villages taking part in the ORDEV competition for the “ideal village”[1]. The exact population is somewhat obscure, as data from BWADC report 4’697 inhabitants, while locals estimated it to be more than 10’000. The *omda* of the village, who lives in Damanhur, seems to come from a rich and powerful family; his brother was sitting in the Shura Council (Parliament Chamber). Unfortunately we did not have the chance to meet neither the *omda* nor the *sheikh baladi.*

Many people in El Haganeya work in the industry and service sector (the village is anyway very close to Damanhur) and only 20% of the households have a stable.

It seems like all services are present in the village, including a health center, making it a “modern village”, according to our talking partner. Furthermore, an event was organized last year for the World Water Day.

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[1] For this competition, competing villages are assessed according different criteria, such as solid waste management, health, sewer network and environmental cleanliness. Other villages taking part in this competition are El Gharbawy, Zabarna, El Magd and Kom El Hasr. During the first phase, the price was 130,000 EGP plus 2,000 trees. Now, the second phase has started, with an award of 7 mios EGP for the winner. However, in the current conditions of the country, it is not sure that this money will be available

Sanitation

Construction of a sewer network started in 2007 and, though the network is already finished, it is still not operational. NOPWASD has still to build the last pumping station and, once this is done, the village will be connected to El Khairy WWTP (Damanhur). It seems that the budget for the pumping station is available, but acquisition of land, as well approval from the ministries of health and environment are pending.

Consequently, sanitation in the village is still based on bayaras and emptying trucks. There are 2 trucks belonging to the CDA, 1 truck to the Village Council and 5 private trucks. Price per trip amounts to 8.5 EGP for the three first ones, and about 10 EGP for the private ones. The new bayaras are made out of concrete, the old one with bricks.

The village has a well-functioning solid waste management system. Each household pays 3 L.E./month for the collection of the solid waste. There is source separation of organic waste and we were told that this was used as a fertiliser.

Drinking water

The water supply is good, with no problems regarding pressure and all households have water meters. However, the old network is damaged.

Kabeel

Date: 22.11.2011

Interviewed: Omda Abd El Wahab Hagag and his grandson, Eng. Yasser Ismail

General characteristics

Kabeel is a small village, with a population of less than 2’000 inhabitants, according to data from BWADC, and around 5’000 people, according to the estimation of the *omda*. Its old part is built on a small hill, with a newer and not so dense part around it, at the level of the fields. According to the *omda*, the village is restricted between the canal from the one side and a drain from the other side.

There are no industrial activities in Kabeel, nor any kind of services (school, health center, associations…) but a huge mosque is currently under construction, financed by the omda himself and his sons. The omda is also willing to give a piece of land of about 500 m^2 for a treatment system or pumping station.

Sanitation

An informal sewer network has been constructed but it is of low quality, with frequent blockages (every 1-2 weeks) which lead to spills on the streets. The pipes are made of plastic, with small diameter (4-6 inches) and shallow (about 1 m or less). Wastewater is discharged into the drain right outside the village, which then flows to Bakr drain, about 1 km away.

Despite the frequent need for maintenance, there is no special person responsible for this task and people are fixing problems themselves when they occur. The lower parts of the village face the most problems; this may be due to the fact that outlet is underground, under the level of the drainage channel, which makes its behaviour hydrostatic for some distance. Besides, some pipes may be broken.

Manure seems not to be a problem in Kabeel, as people seem to avoid dumping manure in the sewers to avoid clogging. Moreover, the number of animals in the village is rather low (1-2 per household), since people are quite poor. It looks like stables have a dirt floor, which absorbs most of the liquid part of the manure, while solid part is removed, dried and applied on fields.

There are no apparent problems with groundwater either, probably thanks to the hill the village is built on and we were told that the canal was at its highest level during our visit. . However, wastewater saturates the soil at places, which creates problems for the foundations and walls of buildings (capillarity).

Drinking water

Water supply dates back to the ‘60s and still seems to be in a good shape. There is also a water meter in every house. The only problem appears to be the pressure and motors are needed for water to reach the higher floors of the buildings.

Figure 3 Satellite image of Kabeel (GoogleEarth)

El Shoka

Date: 22.11.2011

Interviewed: Omda Mohamed […]

General characteristics

We first went to El Shoka at 20.11 but did not find the omda. However, it seems that some villagers called the secret police at that occasion, which then provoked a phone call from the latter to BWADC and us to be accompanied by a member of BWADC security during the next visit.

As a matter of fact, the omda seemed very suspicious and not cooperative at all. He was even reluctant to show us the village, asking for formal orders from the authorities. This issue was solved after a phone call with the secret police. In all case, this village does not present the necessary enabling environment for a study such as ours.

El Shoka is said to have about 3’000 inhabitants. The whole municipality contains more than 30’000 people, distributed in 20-25 villages and hamlets. The omda is very busy and the omodeya is quite big.

El Shoka seems to be famous for its cheese industry, as well as honey and furniture processing. Two cheese factories are around the village and several small ones inside it. Most people are however farmers and every household has animals (1-5 depending on its economic status).

There are no active NGOs, but a health centre at the border with Basateen village. The omda reports high levels of liver and kidney diseases, which may be related to the bad quality of the water supply and use of polluted groundwater.

Lots of houses in the village had new-looking facades, suggesting that people are still quite well-off.

Sanitation

When we visited it, the village was full of mud and spills of wastewater. The villagers financed an informal sewer network which is not functioning; pipes have a small diameter and are often blocked, cement pipes have cracks and it is to be mentioned that manholes are quite elevated. The main chambers (not manholes) are often emptied with an emptying truck, costing 10-15 EGP/trip. Wastewater from El Shoka is disposed of in Zahra Bayaria drain, while nearby ezbas dispose in Tokba drain.

About half of the village population are connected to this network (mainly those living close to the drain), while the other half still relies on bayaras. Bayaras are built in brick and cement, without lining and with addition of salt. They reach sometimes 3-5 meters deep and have to be emptied every 2-4 weeks.There are two trucks for emptying the bayaras, one of which belongs to the Village Council and the other is private. One trip costs 20-30 EGP. It is mentioned that two trucks are enough for the village.

Groundwater is not a problem in the village, as it is said to be about 10-15 meters underground. As a matter of fact, part of the village lies on a small hill.

Drinking water

There are two different water supply networks: the old one, more than 100 years old, still in use, and the new one, about 2 years old. The new one still does not supply water at the household level because the pressure would damage the old house connections. As a consequence, only 15-20% of the population is connected to the water supply, while the rest cannot afford the 2’000 EGP that the connection costs. The *omda* does not have a water supply connection himself and his family is still using groundwater, which is said to be of low quality. There is no clear information from the Company about when the water supply network will be finished.

APPENDIX 3: Field notes from selected ISSIP Batch 2 villages

Beheira - 18-21 March 2013

Team members: Philippe Reymond, Colin Demars and Mohamed Hassan Tawfik
Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Framework and objectives

This four-day field trip has taken place with four main objectives:

1. Visit villages preselected for Batch 2 of ISSIP1 “decentralized component”
2. Get an overview of the sanitation situation in each villages
3. Find the potential sewer outlet(s) where it would be possible to take samples
4. Select at least three villages for further studies, including household surveys and sampling campaign, in the framework of the ESRISS Project’s *Material Flow Analysis* component.

Programme

- 18 March: Arrival in Damanhur, meetings with the Chairman, the RSU, ISSIP local team and the head of the Central Lab. Preparation of the field visits.
- 19 March: visit of the villages *Minshet Nassar, Al Daramalli (both in Project 19)*and *Al Azmili (Project 12)*
- 20 March: visit of *Kawm Azizah (Project 14)* and *Al Haderi (Project 13)*
- 21 March: visit of *Kawm an Nuss (Project 9)*

Before going to any village, we visited the respective Village Council to explain the project, get support and get the name and contact of the omda/sheikh baladi or the number of a potential facilitator in the villages.

Organisation

This field trip has been organised with the support of:

- Dr. Rifaat Abdel Wahaab, Head of the Research & Development Dept in HCWW
- Eng. Khaled Nasr, Chairman of Beheira Water and Drainage Company (BWADC)
- Eng. Ahmed Al Sharnoby, Head of the Dept for International Cooperation in BWADC
- Eng. Ahmed Mitkees, Head of ISSIP PM/TA Local Team in Beheira
- Eng. Hassan Fishawy, Head of the Technical Sector in BWADC

Miscellaneous

- The observations in Google Earth are provided in a separate KMZ file.
- Minshet Nassar, Haderi and Kawm an Nuss were selected for further studies

Batch	Project No.	Village	Coordinates	
			Latitude	longitude
2	9	Kawm an Nuss	31°10'43.60"N	30°14'7.10"E
2	12	Ash-Shami+Al Azmili	31° 5'20.77"N	30°22'52.02"E
2	13	Al-Haderi	31°10'21.62"N	30°20'47.61"E
2	14	Kawm Azizah	31°11'0.74"N	30°19'54.17"E
2	19	Al Daramalli	31° 5'13.02"N	30°24'33.23"E
2		Minshat Nassar	31° 5'10.99"N	30°23'57.95"E

Main observations

All villages visited during this trip are preselected for Batch 2 of ISSIP1 decentralized component. Project numbers refer to those provided in ISSIP *Memorandum for the Staged Implementation of Decentralized Sanitation Systems*, February 2013.

Minshet Nassar *(Project 19)*:

- The neighbouring village 1km to the south, Sharaf el Din, is situated only 600 m from the starting point of a drain; this drain could be used for in-drain polishing in case it is decided that Sharaf el Din will be served.

Daramalli *(Project 19)*:

- In 2010, the villagers of Daramalli, Bayumy and Besh Beshy (the two neighbouring villages east along Mahmoudia canal) built two sewer lines (on each side of Ganabyat Sahaly canal) for the three villages, discharging wastewater in El Khairy drain; unfortunately, it was not professionally designed and is not working properly. It looks like they should also be served together in the future.

Kawm Azizah *(Project 14)*:

- The position of the village along the drain, the location of the existing sewers and the space between the houses and the drains would allow the construction of anaerobic baffled reactors (ABR) at the different discharge points of the existing sewer systems, in case enhanced primary treatment is legally accepted.
- The village is divided in two parts by a large drain.

El Haderi (mentioned as Iz. Al Hadidi in ISSIP memorandum) - *(Project 13)*:

- Presence of large aquaculture ponds between the village and the drain (see Figure 8 and Figure 7); there is a great opportunity to use these ponds as a polishing step.
- Poor village with a rich land owning family; bad sanitation situation

Kawm an Nuss *(Project 9)*:

- Kawm an Nuss: villagers already built their own sewer network, discharging in a drain one kilometre away (see Figure 10)
- The population number seems to be way above 1,500 inhabitants
- What has been identified as “village 27”, 700 m. south of Kawm al Nuss, looks rather like a cemetery, based on Google Earth.

Minshet Nassar

Date: *19.03.2013*

Markaz / Village Council: *Damanhur / Zawyet Gazal*

Local team: Eng. Ehab Darwish (BWADC), Eng. Mohab El Tohfa (ISSIP PM/TA), Kamel (driver and member of the security of BWADC)

Interviewed*: Sheikh El Balad (Mosaad Nassar), phone no: 3472856 ,*

Other contact(s): Mr. Abd el Razak (relatives of the omda): 01008727794

Status: *selected for further studies*

General characteristics

- Minshet Nassar is the mother village of an omodeya of 7 villages, including Daramali, Besh Beshi and Sharaf el Din. The omda died recently, but there is a sheikh el balad.
- Minshet Nassar has 1917 inhabitants according to the official data from 2012. The sheikh El Balad gave the number of 3000 inhabitant.
- There is one chicken farm outside the village and no other industry.
- The village is located between Mahmoudia canal and two other smaller canals (El Khadra, Ganabyat Sahaly) which lead to a very high water table (30-50cm).
- Most of the inhabitants are farmers (about 90% according to the information from the Sheikh El Balad); there is one Agricultural Association and a health centre in the village which serves the whole *omodeya.*
- There is a drain starting one kilometre from the village, and only 600 meters from Sharaf el Din.

Figure 1: Starting point of a drain

Sanitation

The village is entirely served by sewers, with the following features:

- Very shallow: average of 50 cm depth
- Frequent blockages
- 3 to 5 main sewer networks. Possibility to take samples in two of them: one with 18 houses connected plus a mosque (which could lead to a more dilute wastewater), another one with 15 houses. Both outlets are in the Ganabyat Sahaly Canal. A third sewer network received WW of 30-40 houses, the outlet is in the El Khadra canal; but it is below the water level.
- The network is made of plastic pipes (about 4 inches) which are said to be cracked.
- Second sewer has been rebuilt 2 months ago. The old one was 15 years old. It cost about 6000 LE to connect the 15 houses
- O&M: every house pays 50-100 LE/month. There is no specific person responsible for the maintenance. Unclogging is done with wires.

Drinking Water

- Good pressure (DW station close to the village, big buildings on the left of the map), Sheikh El balad has mentioned that there are cracks in the pipes which affect the quality of the drinking water.

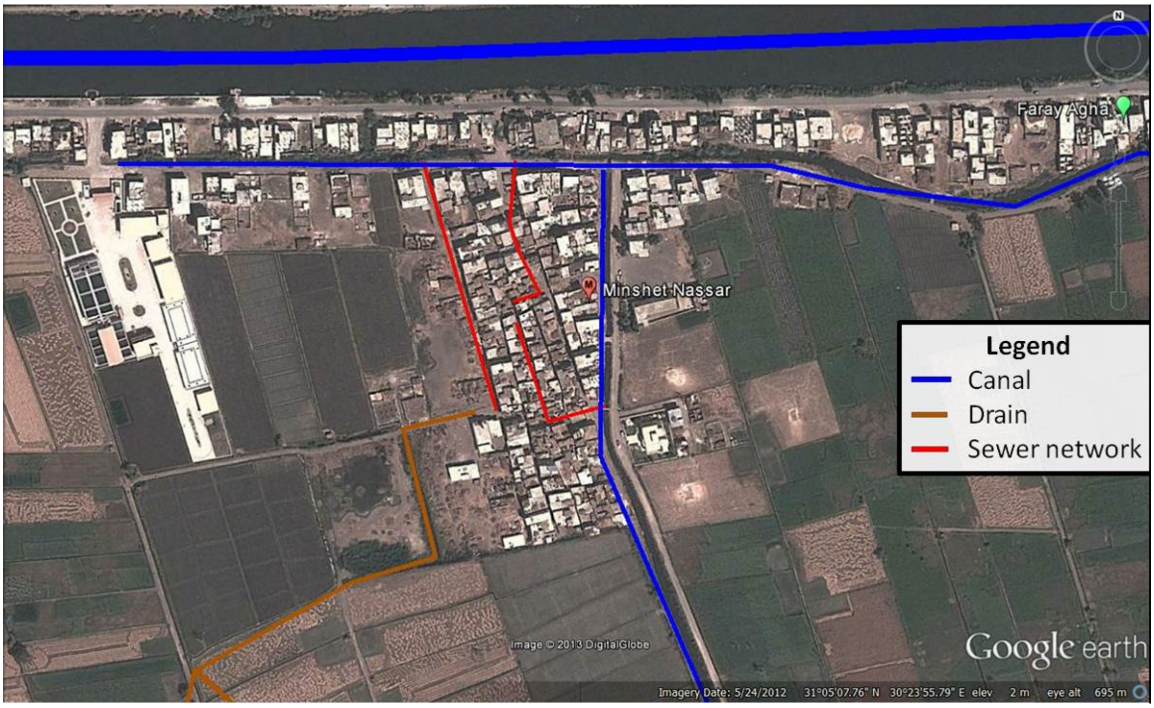


Figure 2 Map of Minshet Nassar

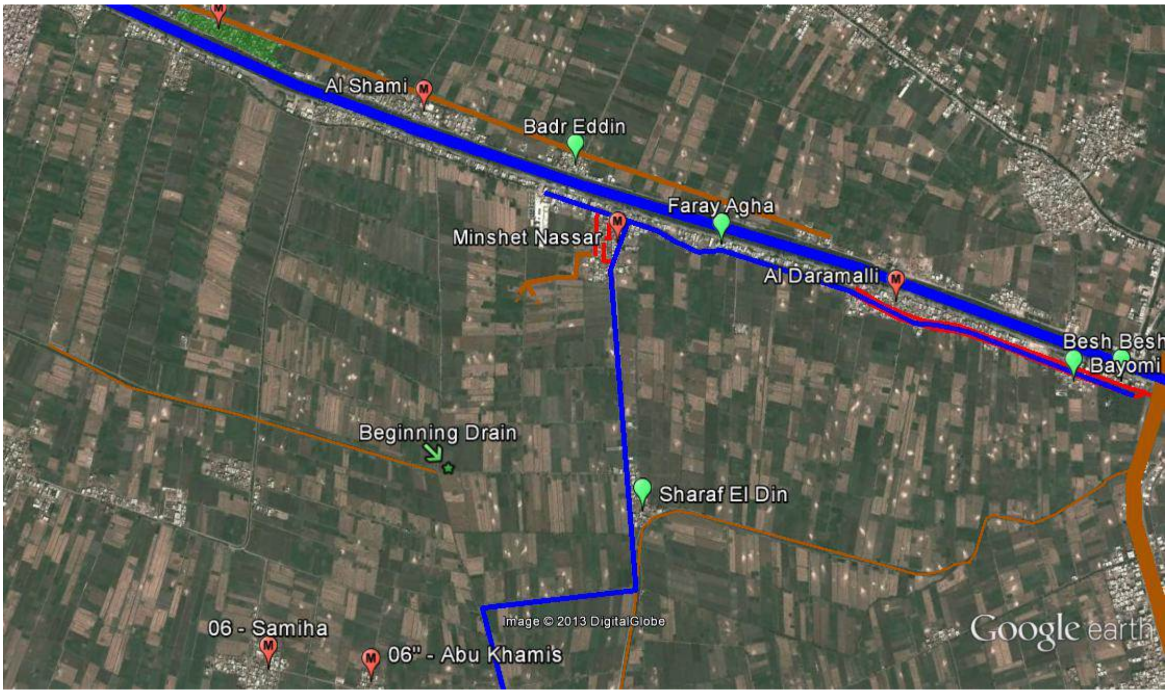


Figure 3: Position of Minshet Nassar and Sharaf el Din in relation to the identified starting point of a drain.

Daramalli

Date: *19.03.2013*

Markaz / Village Council: *Damanhur / Zawyet Gazal*

Local team: Eng. Ehab, Eng. Mohab

Interviewed: *Omda; local villagers: Mr.kamal Gad Abd Rabo (01224903132) and Mr.Mohamed Saiid Abo Shnab (01065083737).*

General characteristics

- 5 villages near each other: Minshet Nassar(1450), Faray Agha(188), Daramalli (1330), Besh Beshy and Bayumy
- All are located along the Mahmoudia canal with the Ganabyat Sahaly canal on the southern side
- 80% are farmers; there is one chicken farm outside the village; the health centre and the Agricultural Association are in Minshet Nassar.

Sanitation

- Mostly sewered, about 5% of houses have bayaras
- Have just built a new sewer for the 3 villages (Daramalli, Bayumy and Besh Beshy). Sewer has been built by local workers under the lead of a committee in 2010, without consultant. Two sewers, one on each side of the Ganabyat Sahaly canal, which join downstream. The outlet is on the El Khairy Drain.
- The network has cost an average of 300LE/person.
- NOT WORKING (semi clogged network with weak plastic pipes) probably because of the very low slope(about 1,4 meter depth difference – from 60 cm to 2m depth for a length of 2 km). The sewage overflows through holes made in the manholes and flows in the Ganabyat Sahaly canal. However there is still a significant flow at the outlet of the pipe in El Khairy drain.

Drinking Water

The quality is good but the pressure is weak.

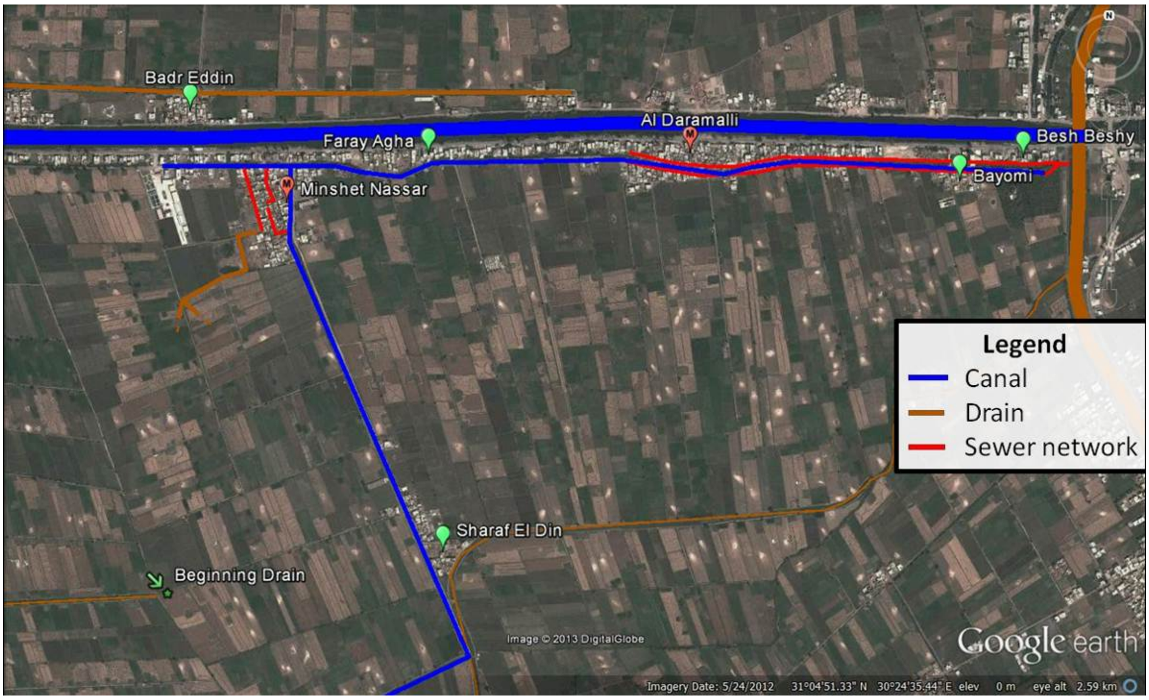


Figure 4: General view of Minshet Nassar, Faray Agha, Al Daramalli, Bayumy, Besh Beshy and Sharaf El Din

Azmili

Date: *19.03.2013*

Markaz / Village Council: *Abu Hommus / Dmesna*

Local team: Eng. Ehab, Eng. Mohab

Interviewed: *Sheikh al balad*

General characteristics

- Mostly civil servants, no health centre (health centre in Dmesna), no industrial activities
- No CDA
- Between by Mahmoudia canal in the south and a drain in the north
- People indicate around 215 houses (tbc)
- ~ 2 animal/house
- Ground water level 2-4 m

Sanitation

- Mostly bayaras, some discharge directly in the drain.
- 2 different pumping trucks work in the village (but none from the village itself): a private one, and one from the village council. Cost ~ 20LE/trip. Bayaras emptied every 20 days to every month.
- For the village council truck service, people go to the village council to make the request, and then have to wait for 1-2 days
- Bayaras are not sealed and their construction cost 1,500-2,000 LE

Drinking Water

- Only 50% houses with tap. Others use the public tap
- The pressure is not good; people use pumps if they can afford it.

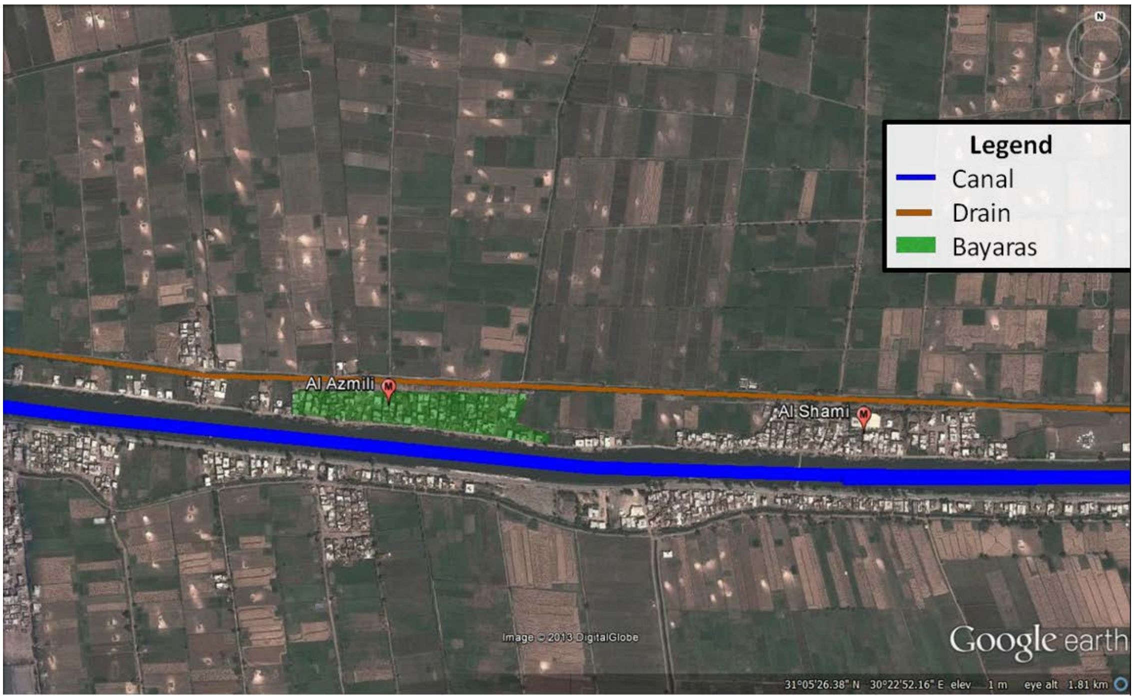


Figure 5: General view of Azmili and Shami

Kawm Azizah

Date: *20.03.2013*

Markaz / Village Council / Omodeya: *Abu Hommus / Besentway / El-Nakhla el-Bahareya*

Local team: Eng. Ehab

Interviewed*: A villager Mr. Azaz El Taweel , phone number (0111340860), a doctor*

General characteristics

- Surrounded by guava and orange tree farms; people are mainly farmers, but mostly don't own land.
- One health centre , one charity association , two schools and no industry
- Sayef drain passing through the village, water level is low.
- Number of inhabitants is 1407 (according to the village council) and 1500 (according to Mr.Taweel) , about 200 buildings in the village with an average of 3 households per building
- The ground water table is high (about 1 meter)
- Many new houses have been recently built on the north-east part of the canal.

Sanitation

- The two systems are present in the village in an equal percentage 50-50% (half the population are using bayaras and the other half are using informal sewer networks)
- There are 5 main informal sewer networks in the village in addition to some individual pipes connected directly to the drain from the nearby houses. 3 networks (north of the drain) of the 5 have been built since 3-4 years ago which didn’t require any maintenance until now (was designed by engineers). The other 2 networks have been built since 10-15 years ago and the villages did a total renovation to them recently which costs 1,000 EGP per house. Each sewer network collects the WW of about 20 houses. There is only one outlet where it would be easy to take samples.
- Sewer pipes have usually 10 inches width.
- People who are living in the part of the village where the slope of the land is very low are still using bayaras. Schools are using bayaras as well.
- The quarter on the north part of the drain have bayaras and sewer system (recently built). It seems that only the overflow of bayaras goes to the sewer.
- Building bayaras cost about 3,000 EGP
- Bayara emptying done by private trucks, which discharge in the drain
- The majority of bayaras are not sealed
- Cost of one trip to empty the bayara is 25 EGP per trip , emptying bayaras every 20 days (didn’t mention seasonal variations).

Drinking water

- There is water supply in the village but the pressure is low; many people use pumps

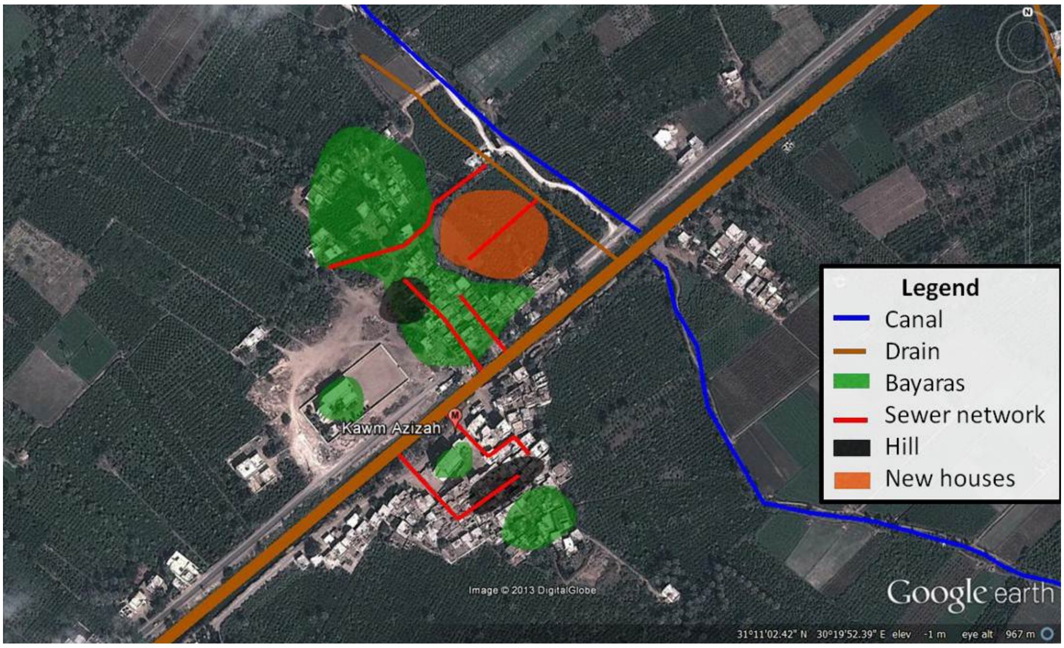


Figure 6: Map of Kawm Azizah

El Haderi

Date: *20.03.2013*

Markaz / Village Council / Omodeya: *Abu Hommus / Besentway/ El-Nakhla el-Bahareya*

Local team: *Eng. Ehab*

Interviewed: *Mr. Nabil El Tanikhi: a land owner , phone number (01068480381)*

Status: *selected for further studies*

General characteristics

- Population number according to the village council of Besentway is 1854 inhabitants, while the number of population according to Mr.Nabil is 5,000 inhabitants! To be estimated through another way.
- Mainly farmers, one cattle per house in average; solid manure is used in the field while liquid manure is dumped in the drain
- There are two schools , no health centre , no associations , one cattle farm outside the village(2 Km far from the village)
- There are 2,500 households (to be confirmed).
- El Nakhla El Baharia (El Dakhla El Gedida) canal is passing through the village
- Ground water table at depth of 110 cm
- No health centre, no industrial activity, one cattle farm outside the village
- Fish farming is practiced in large aquaculture ponds between the village and El Malh drain.

Figure 7: El Malh drain and one of the large aquaculture ponds

Sanitation

- People are using bayaras as the only option to manage waste water
- About 10 trucks are serving upon request, one of which belongs to the village council; none is from the village itself

- One trip costs 30 EGP for the private truck and 20 EGP per trip for the truck belonging to the village council ; service is free for the mosque
- Disposal in Ghozlan drain even if the water from this drain is used for irrigation; sometimes disposal in the neighbouring field,
- Emptying frequency: once a week
- Bayaras are permeable (in/exfiltration takes place)
- It costs about 1,500-2,500 EGP to build a bayara
- One of the bayara emptier his name is *Morad Omara , phone number: 01113504405 , 01112809011*

Drinking water

- Good drinking water quality but low pressure and frequent interruption

Figure 8: Map of Al Haderi

Kawm an Nuss

Date: *21.03.2013*

Markaz / Village Council: *Kafr el Dawar/Bulin*

Interviewed: *Mr. Ahmed Harb (the head of the village council in Bulin) , Phone number: 011290292;*
Mr. Saad Abo Safia (one of the villagers who had a role in the construction of the informal sewer network and is responsible for its maintenance) , phone number: 01225868183;
Mr. Mohamed Azazi from the village council/local unit, accompanied us to the village;
There is no omda, but a sheikh al balad

Status: *selected for further studies*

General characteristics

- The village is dense with two- storey buildings and more. There is a high growth rate.
- According to village council there are 1500 inhabitants (census from 2006) and 6,000-7,000 according to Mr.Saad Abo Safia; about 400-600 houses and 1,000 households
- Most inhabitants are farmers. There are around 4 animals /house
- There is one charity association, one health centre, one school (working 2 periods), one milk factory and three chicken farms inside the village.
- Tuson Drain is passing in the south of the village
- The depth of groundwater lies from 20 cm to 3 meters, according to the position in the village (which is built on a small hill)
- No aquaculture
- The word ***Kawm*** (in *Kawm an Nuss*) means “heap”, which is the right description for the village as the centre lies on a higher level.

Sanitation

- Informal sewer network and some bayaras in isolated part of the village (~5%)
- The informal sewer network was built 9 years ago by the villagers; the construction cost about 650LE/household, depending on family income. On top of that, the connection of a household to the network costs 100-150LE. The diameter of pipes is 12-14 inches.
- The sewer is frequently clogged (1x/week). There is one responsible for the maintenance (Mr.Saad Abo Safia), who brings workers to unclog with wires. The maintenance costs 10 EGP per household per week.
- The village network is connected to a 1 km-long pipe which discharges in the Tuson drain. The flow is high (50-150 l/min).
- Rain water goes to the same network which increases the flow in the rainy season.
- Bayaras are located in isolated part of the village but also by people who do not have the money to pay for the connection to the sewer network. One trip costs 40LE/trip. Most people use the emptier from the village council Mohamed Abd El Rasol (01113208219). The discharge

point is in small drain. Some of the bayaras are sealed other aren't. Farmers do not use septage on the field. The school, the health centre and the milk factory have bayaras.

- It costs 1000 EGP to build bayara (not sealed) and 2500 EGP to build a sealed one.
- The liquid manure goes in the sewer or is thrown in the canal. The solid part is used in the field.

Drinking water

- The quality is bad and low pressure, people are using pumps and sometimes use groundwater

Figure 9: Map of Kawm al Nuss

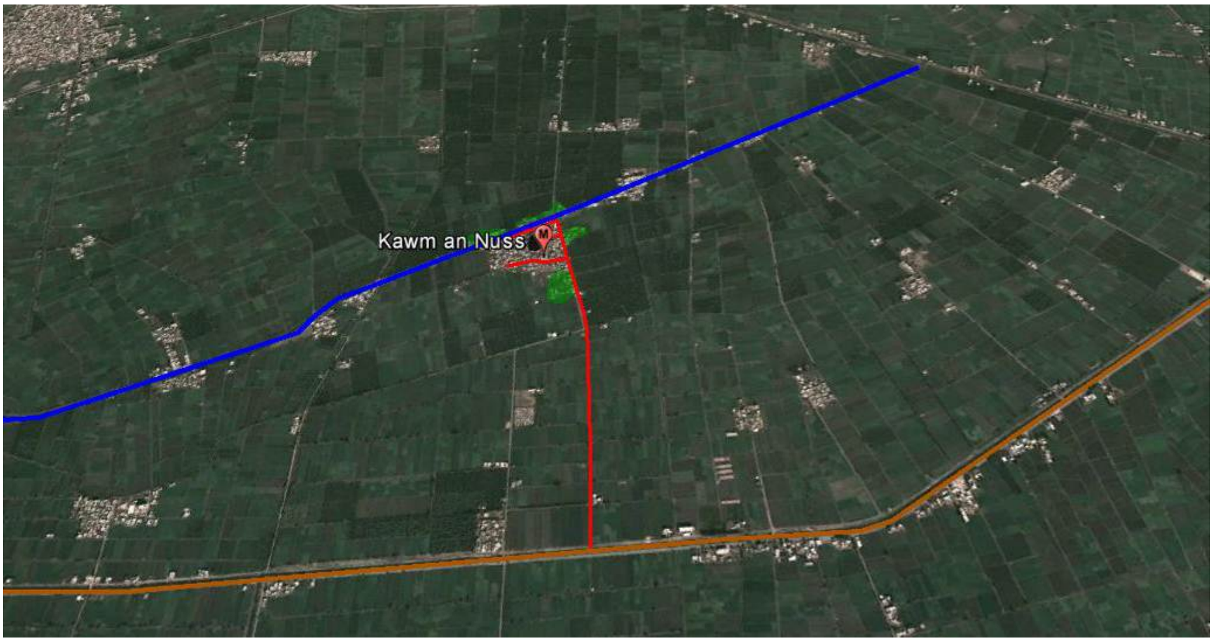


Figure 10: Kawm an Nuss' sewer network and discharge point

APPENDIX 4: Field Notes - Village Selection Campaign 2014

Beheira - 23-26 March

Team members: Philippe Reymond, Colin Demars and Kareem Khaled Hassan

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Framework and objectives

This four-day field trip has taken place with three main objectives:

1. Visit several sewered villages to get an overview of the sanitation situation in such villages
2. Identify potential sewer outlet(s) where it is possible to take samples
3. Select at least two villages for further investigation, including household surveys and a sampling campaign, in the framework of the Material Flow Analysis component of the ESRISS Project.

Methodology

Based on the satellite images and GIS maps of several Omodeyas around Damanhur, four Omodeyas were selected. The selection criteria were: i) isolated villages with ii) a size from 1000 to 3000 inhabitants iii) relying on "informal" sewer network(s). First, the respective Village Councils were visited to explain the project, get support and get the contact of the Omda/Sheikh El-Balad for the selected villages. 2-4 villages were visited in each Omodeya.

Programme

- 23 March: Arrival in Damanhur, meetings with the head of the Department for International Cooperation at the Beheira Water and Drainage Company (BWADC), the Chairman and the GIS department. Visited the selected villages in Nidiba Omodeya: *El Hamraa*, *Destawy*, and *Tarbees*.
- 24 March: visited the selected villages in Fisha Omodeya: *Saadeyah* and *Fisha al Safra.*
- 25 March: visited the selected villages in Gawad Housny Omodeya: *Kawm abo Khalifa*, *Kawm Qalbat* and *El Qasr*.
- 26 March: visited the selected villages in El Abaadia Omodeya: *El Gamamizah, El Hamraa*, *Minshet Saleh*, *El Arab* and *Hilal Husain*. Meeting with the head of the central lab for Wastewater.

Organisation and acknowledgements

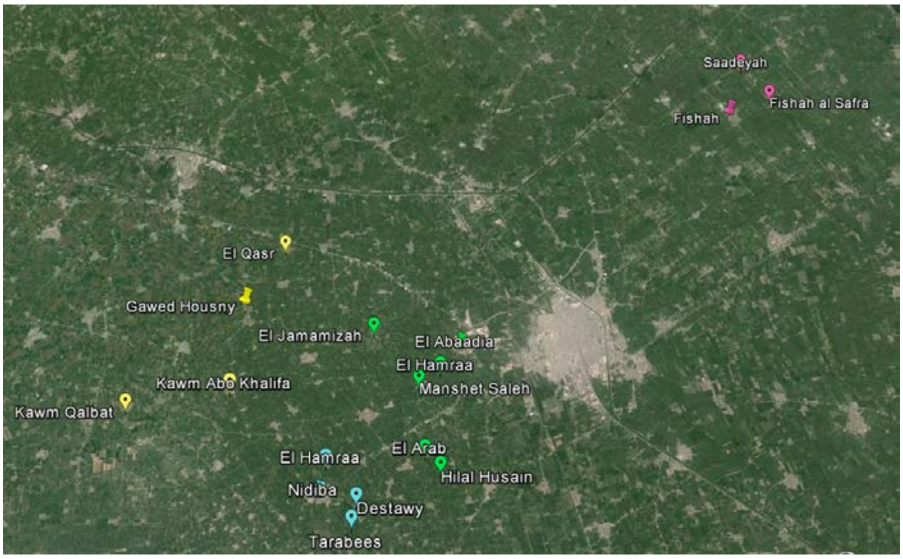
This field trip has been organised with the support of:

- Dr. Rifaat Abdel Wahaab, Head of the Research & Development Dept in HCWW
- Eng. Khaled Nasr, Chairman of Beheira Water and Drainage Company (BWADC)
- Eng. Ahmed Al Sharnoby, Head of the department for International Cooperation in BWADC
- Eng. Sahar Omar of the GIS department in BWADC

Miscellaneous

- The observations in Google Earth are provided in a separate KMZ file.
- Kawm abo Khalifa and Fisha al Safra were selected for further investigations.

Village	**Omodeya**	**Coordinate**	
		Latitude	Longitude
El Hamraa	Nidiba	30°59'44.96"N	30°22'37.91"E
Destawy		30°59'2.71"N	30°23'19.93"E
Tarabees		30°58'38.43"N	30°23'15.22"E
Saadeyah	Fisha	31° 8'19.08"N	30°32'31.01"E
Fisha al Safra		31° 7'33.32"N	30°33'8.95"E
Kawm Abo Khalifa	Gawed Housny	31° 1'9.43"N	30°20'23.97"E
Kawm Qualbat		31° 0'47.46"N	30°18'8.47"E
El Qasr		31° 4'2.44"N	30°21'22.52"E
El Jamamizah	El Abaadia	31° 2'18.55"N	30°23'32.29"E
El Hamraa		31° 1'31.25"N	30°25'3.75"E
Manshet Saleh		31° 1'15.39"N	30°24'35.64"E
El Arab		30°59'55.42"N	30°24'46.14"E
Hilal Husain		30°59'36.87"N	30°25'6.84"E



Main observations

- The official data concerning the population number in villages are not trustful. For villages with a relatively same size the official data show a significant difference. In a village where the official data were told to be from the 2013 census, the Sheikh el Balad said that the last census happened 10 years ago. In order to estimate the number of inhabitants in the village, a crosscheck should be done between: the official data, the estimation from village authorities and the estimation based on the number of houses and number of people per house.

- A relatively large proportion of villages in Beheira governorate do have informal sewer network(s).

- Different systems have been put in place by the villagers to prevent sewer clogging:

    - Pumping canal water directly into the network. Either through a pipe introduced directly into the network (Kawm abo Khalifa), through a bayara emptying truck (Kawm abo Khalifa, Kawm an Nuss), or through an installation which brings pumped water directly into a manhole (al Jammamizah)

    - Modified manholes (Fisha): The main line passing in the manhole is not open; it consists of a perforated pipe which prevents solid waste to enter the sewer system.

    - Interceptor tanks (Tarabees): small bayara in front of each house, allowing the settling of solids. The overflow of the bayara is connected to the network

    - Forbidding the discharge of liquid manure in the network is practiced in some villages (e.g. Kawm an Nuss)

- El Hamraa and Manshet Saleh are close to the beginning of a drain, consequently there is a possibility to make an in-drain polishing for the nearby villages.

- Village names in Google maps are not always right.

- Two villages visited are not connected to the drinking water supply network; others have a very poor water supply.

El Hamraa (Nidiba)

Date: 23.03.2014

Markaz / Village Council: Damanhur / Nidiba

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed*:* Talaat (villager): 01023388064

Status: Not selected for further studies

General characteristics

- It seems that there is no Sheik el Balad in the village.
- El Hamraa has 1600 inhabitants according to villagers (~250 houses).
- Most inhabitants are farmers, there is around 3 cows per house
- There is no significant difference in salary income
- There is one mosque but no health-centre, neither industry or school

Sanitation

The village is entirely served by an informal sewer network:

- The sub-lines are connected to one main line, which is built under the road going to the north direction. The wastewater is discharged in the drain by a 1 kilometres pipe. The outlet is under the drain water surface level (it might be possible to take samples when the drain level is really low).
- Frequent clogging occurs: every day in the sub-lines and every 2-3 days in the main line.
- There is no responsible person for sewer maintenance.
- The network was built in 2012; it costed 1000 LE /house.

Drinking water

- There are frequent interruptions, however it has good pressure (no pump).

Destawy

Date: *23.03.2014*

Markaz / Village Council: *Damanhur / Nidiba*

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed*: Ashraf (farmer): 01092706417*

Other contact(s): Eng. Shaban (freelance engineer who built the sewer network)

Status: Not selected for further studies

General characteristics

- There is no Sheikh El-Balad in the village.
- According to villagers, there are between 2000 and 2500 inhabitants
- The main occupation is farming, but there are still some shop owners. In average, there are 2 cows per house.
- The ground water table is deep (~6m)
- The only non-residential building is a mosque.

Sanitation

The village is entirely served by an informal sewer network:

- It was built by the villagers 6 years ago, with the help of an engineer working at the Holding Compagny (Eng. Shaban). It is composed of two main lines. There is only one outlet which is discharging the wastewater in a drain at 200 m north-east from the village. The outlet in underneath the drain surface, therefore is not possible to take samples.
- The network is clogged every day. It is not clear if there is or no a responsible person for sewer maintenance.
- The liquid manure ends up into the network
- The overall costs for the village networks are: construction 46’000LE, maintenance 500LE/house/year.

Drinking Water

- Good water supply in general, however there are some interruptions in summer. The pressure is low and every house has a pump.

Tarabees

Date: *23.03.2014*

Markaz / Village Council: *Damanhur / Nidiba*

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed*: Naser Briah (villager): 01069380959*

Status: Not selected for further studies

General characteristics

- 1000 inhabitants
- Deep ground water table (>6m)

Sanitation

- Each house has its own bayara (1*1*2m) connected to the sewer network. The bayara play a role of settling chamber; only the overflow end up in the sewer network.
- Bayaras are emptied manually every month.
- The network consists of one main line. The flow at the outlet was very low during the visit; according to the villagers it is caused by the leakage occurring in the bayaras.
- Clogging is not frequent (once a month)

Drinking Water

- The pressure is low, each house has a pump.

Saadeyah

Date: *24.03.2014*

Markaz / Village Council: *Damanhur / Fisha*

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed*: Mohamed (Omda's Son): 01118565282*

Status: Not selected for further studies

General characteristics

- 2417 inhabitants according to census 2013 (10'000 according to the omda's son)
- Mostly inhabitants are farmers, however some of them are working in a plastic recycling factory in the village.
- There are three schools and seven mosques
- The buildings have mainly two storey

Sanitation

The village is entirely served by an informal sewer network:

- 5 independent lines are discharging in the drain**.**
- There is no responsible person for sewer maintenance.
- Some lines are often clogged, others, with a bigger pipe diameter, hardly ever clogged.
- There is a poultry farm which discharges its wastewater in the drain.
- Not possible to take samples.
- The animals' liquid manure is drained directly to the sewer network.

Drinking Water

- The drinking water is turbid and each house has its pump.

Fisha al Safra

Date: *24.03.2014*

Markaz / Village Council: *Damanhur / Fisha*

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed: *Masoud El-Bass (Omda's Assistant): 01211100975, 01114022072*

Status: *Selected for further studies*

General characteristics

- There are 2600 inhabitants according to the Omda, 1270 according to the public authorities.
- Most of villagers are farmers (~75%), the rest are civil servants. On average, there is two cows per house
- The village has mainly two storey buildings. There are three schools and two mosques.
- There is no available fresh canal water for irrigation; therefor the farmers have to irrigate their crops using drainage waste water from the drain, leading to bad crop yield.
- Very collaborative Omda's Assistant

Sanitation

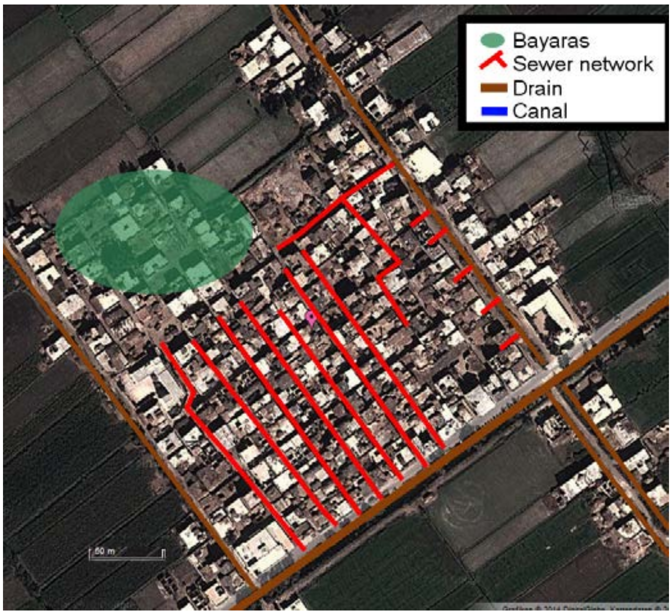
The village is served mostly by a 20-years old informal sewer network, there are some bayaras, but the proportion is not clear (~5%?). Concerning the network:

- There are six main lines which directly discharge in the main drain south the village. Each line collects WW from 20-30 houses. In the eastern part of the village, each house has a pipe discharging directly to the drain. Clogging occurs every day and villagers fix it by themselves.
- During our visit, one of the lines was getting renewed. The 21 connected houses paid 500 LE/house. Each villager had then to install his own house connection linked to the main network line. The Omda estimated its average cost from 7'000 to 10'000 LE/line. In order to avoid the accumulation of solids in the new line, the main line passing through the manhole is not completely open, instead it is perforated in order toallow only the liquid to get in the network.
- The Omda told us about a wastewater treatment plant project that could be constructed outside the village near to the Khairy Drain.

Drinking Water

- The pressure is good, no pump are needed, however there are frequent interruptions. The villagers complain about the bad taste of water.

- In some places, the drinking water pipe is really close to the sewer network, which could lead to drinking water contamination in case of low pressure in the drinking water pipe.



Kawm Abo Khalifa

Date: *25.03.2014*

Markaz / Village Council: *Damanhur / Gawad Housny*

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed*: El-Hag Sabry (Sheikh El-Balad): 01149174790, Salah Saad Galal (Volunteer at El Andalus NGO): 01145414355*

Status: *Selected for further studies*

General characteristics

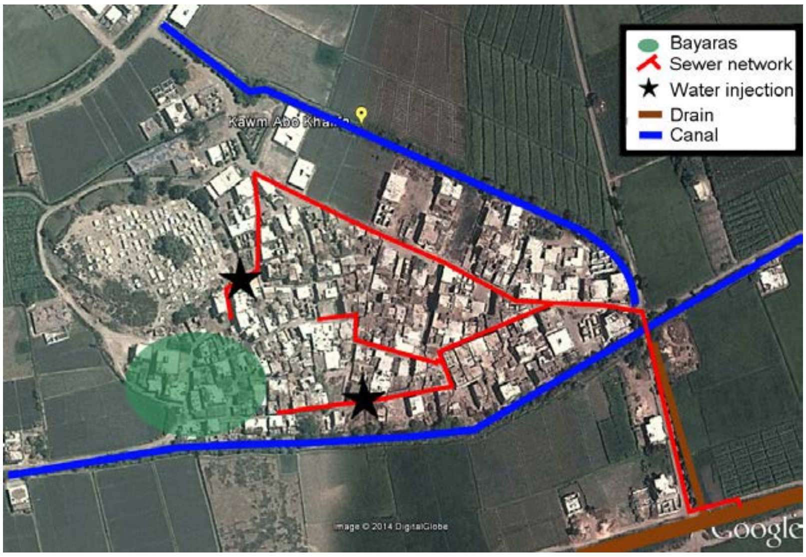
- There are around 2500-3000 inhabitants, around 200 houses according to the *Sheikh El-Balad*.
- Most of inhabitants are farmers. There is on average two cows per house
- There is one school and two mosques.
- The village is situated on a hill. The old part of the village is dense with up to four-storey buildings. There is a chicken farm outside the village, which is not discharging in the sewer network.
- The groundwater is at ~8 m depth.

Sanitation

The village is mostly served (75%) by an informal sewer network installed with the help of a freelancer. Some Bayaras are found in the south-western -part of the village. The ground level in this area is too low to permit any connection to the sewer network; this area is also not connected to the drinking water supply.

Regarding the sewer network:

- There are two main lines, joining and discharging to the Abdel-Hamed drain. Part of the network was constructed by a village association. There is nobody responsible for the sewer maintenance.
- The cost of the main line construction is 500 LE/house, each house had to build its own connection to the network. The network was constructed 20 years ago. Each year, the association collects the money for maintenance purposes: from each house and around 5000-10000 LE from the richer farmers (this amount seems to be over-estimated).
- Most of the stables are directly connected to the sewer network.
- To prevent clogging in the two main lines different actions are undertaken. In the first line (in the north) a bayara emptier empty four times per week his tank (filled with canal water or septage from the adjacent village) into the sewer network. In the second main line, the water from the drain is directly pumped into the sewer network twice a week. Thus the high flow and pressure are washing the settled solids.



Drinking Water

The villagers complain about the drinking water supply. The water is turbid, the pressure is low (need pump) and there is an interruption every morning in houses situated on the hill. There is no drinking water connections in the houses situated in the bayaras zone (~25% of houses).

Kawm Qalbat

Date: *25.03.2014*

Markaz / Village Council: *Damanhur / Gawad Housny*

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed*: Mohamed Basuony (Omda's brother): 01100723686,*

Other Contacts*: Sami Basuony (Omda): 01225121750*

Status: *Not selected*

General characteristics

- ~2000-2500 inhabitants according to *Mr. Mohamed Basuony*.
- 2 schools, 4 mosques, no health care facilities.

Sanitation

The village is served by an informal sewer network, done by a freelancer.

- There is one main line (PVC pipe, 6 inch), discharging in the Khairy drain 6 kilometre further. The system clogs frequently, every 3 days and there is no responsible person of sewer maintenance.
- The network has been constructed 6-7 years ago.
- 10-20 LE per house per month is collected for maintenance.

Drinking Water

- Bad quality of water (is taken from Kawm El Qanater drinking water station) but it has rare interruptions. Every single house has its private pump.

El Qasr

Date: *25.03.2014*

Markaz / Village Council: *Damanhur / Gawad Housny*

Team: Philippe Reymond, Colin Demars and Kareem Hassan

Interviewed*: Mahmoud El-Naggar (Sheikh El-Balad): 01270001505*

Status: *Not selected for further studies*

General characteristics

- According to the *Sheikh El-Balad,* there are 5000-6000 inhabitants, corresponding to 600 houses. This amount does not seem to be realistic given the size of the village. Most of inhabitants are farmers (~85-90 %). There is on average 2-3 cows per house

- The village has two schools, two mosques and one health centre.

- The village is situated at 200m from the Cairo-Alexandria road. The village is dirty, with a lot a solid waste in the street. There is a really high ground water level.

Sanitation

The village is served by an informal sewer network, done by a freelancer.

- There is one main line (concrete pipe, 60 cm), discharging into the Khairy drain at the opposite side of the Cairo-Alex road. At the final section, the drainage water is mixed with the sewage. There is nobody responsible of sewer maintenance

- Cost of the mainline construction is 300 LE/house. Each house connected to the network by themselves. The total cost was 150,000 LE. The network was constructed 8 years ago.

Drinking Water

- Good quality and quantity of water, rare interruptions. The pressure is low, there is a pump in every house

El Jamamizah

Date: *26.03.2014*

Markaz / Village Council: *Damanhur / El Abaadia*

Team: Colin Demars and Kareem Hassan

Interviewed*: Ibrahim Etman (Sheikh El-Balad): 01227518193, AbdelMahdy (Technician): 01141589146*

Other contacts: *Menshawy (Maintenance specialist): 01272379036*

Status: *potential selected*

General characteristics

- According to the authorities, there are 1050 inhabitants. According to *Mr. Ibrahim Etman (Sheikh El-Balad)* there are around 400 houses in the village, average 5-6 inhabitants per house, it means that the total average number of inhabitants in this village is from 2000 to 2400. .
- There are two mosques, no school and no healthcare facilities
- 60 % of the youth in the village are working in Libya as agricultural workers.

Sanitation

The village is entirely served by an informal sewer network, done by a freelancer from Othman Ahmed Othman Contractors Company. The network seems to be well constructed with appropriate slope.

- There is one main line (12 inches), discharging 500m north in the El-Zain drain. During our visit, the drain was full of water (overflowing of canal water?), the outlet was 2 m under the water level. The network was constructed 6-7 years ago.
- The network is frequently clogged; the maintenance is done by the three persons responsible of the maintenance. The cloggage in the main line are fixed by pumping canal water in the network.
- According to Mr. *Menshawy* (responsible of sewer maintenance), the network cost around 500,000 LE and each house paid 5000 LE. According to some villagers, the construction cost between 260 LE/person and 460 LE/person. The persons responsible for sewer maintenance are paid 500LE/person/month.

Drinking Water

- The drinking water quality is good, the interruptions are rare. The pressure is low and every single house has its private pump.

El-Hamraa (El Abaadia markaz)

Date: 26.03.2014

Markaz / Village Council: Damanhur / El Abaadia

Team: Colin Demars and Kareem Hassan

***Interviewed**:* El-Sayed Ahmed Zaid (Sheikh El-Balad): 01285947452

Status: Not selected

General characteristics

- According to authorities there is 450 inhabitants. This number seems much too low according to the ~200-250 houses in the village with an average 5 inhabitants per house.
- 2 mosques, no health care facilities.
- The ground water seems to be really deep (>15 meters).

Sanitation

The village is entirely served by a 10 years-old informal sewer network:

- 2 main lines (12 inches), one was done by Bilal Foundation, serving 90 houses, and the other one was done by the farmers themselves, serving 120 houses. The first outlet is under the drain level and there is no possibility to take samples in the manholes (stagnant water).
- According to the villagers cloggage in the network is rare (every few month)
- The liquid manure is discharged into the sewer network.

Drinking Water

- The drinking water has a medium quality with bad taste but rare interruptions. Every single house has its private pump.

Manshet Saleh

Date: *26.03.2014*

Markaz / Village Council: *Damanhur / El Abaadia*

Team: Colin Demars and Kareem Hassan

Interviewed*:* Mustafa Kamel (Sheikh El-Balad): 01004395398

Status: Potential village

General characteristics

- There are around 4000 inhabitants according to the Sheikh el Balad and 3500 according to official data, but both numbers seems to be over-estimated.

- Most inhabitants are farmers; there is on average three cows per house.

- There are two schools (connected to bayaras), three mosques (not connected to the sewers), no health care facilities. No industry

- They have a NGO called El-Faroq Omar charity.

- The groundwater level is at 1.5-2m

Sanitation

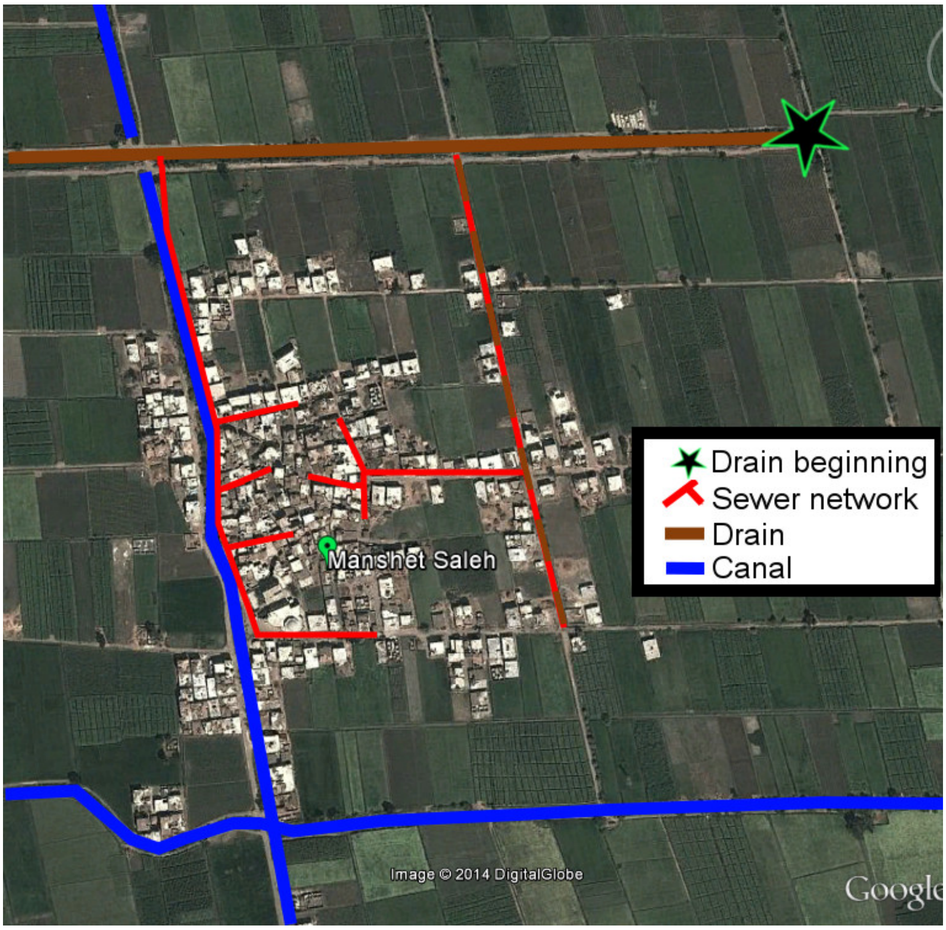
- The village is served by an informal sewer network since 1993. It has been renewed in 2000 and 2004. There are two main lines (12 inches), one was done by the Bilal Foundation, and the other one by the farmers themselves. The informal sewer network construction was supervised by a freelancer for both networks. Each line collects the wastewater of 200-250 houses and discharge it into a drain, situated in the north of the village. Some drain are also discharging in the lhe line on the eastern side of the village. Both outlets are under the water, but the wastewater flow is not directly mix with the drainage and gives the possibility to take some samples.

- The network is clogged on average one time per week.

- The line constructed by the villagers cost 150’000 LE. Maintenance costs are 100 LE per cloggage, what is done by the El-Faroq Omar charity.

Drinking Water

- Really bad water supply: bad taste, no pressure and there are frequent interruptions (~2 times per week). Interruptions can last up to four days (on average 24 hours). Every house has its private pump.


Drain beginning
Sewer network
Drain
Canal
Manshet Saleh
Image © 2014 DigitalGlobe
Google

El Arab

Date: *26.03.2014*

Markaz / Village Council: *Damanhur / El Abaadia*

Team: Colin Demars and Kareem Hassan

Interviewed*: AbdelRahman El Gabarouny (Sheikh El-Balad): 01020699897*

Other contact: Adel Abdelhaleem (Technician): 01006128713

Status: not selected for further studies

General characteristics

- Village is poor, not a lot of farmers.
- ~120 houses, average 10 inhabitants per house.
- 3 mosques, no school, no health care facilities.

Sanitation

- Informal sewer network, done by a freelancer. Same one who is still doing the maintenance.
- 5 main lines (8 inches, 2 are in concrete, 3 are in plastic). They paid 200 LE per person for constructing the system, and 5 LE per bathroom per month for maintenance.
- It clogs 1 time per 2 weeks.
- The network constructed >12 years ago.

Drinking Water

- **Only three houses do have a connection to drinking water**. Other houses fill tanks of low quality of water with rare interruptions. Every single house has its ground water private pump. The village not connected with the public water station; consequently they fill tanks with clean water for drinking and cooking, from a far-away public tap.

Hilal Husain

Date: 26.03.2014

Markaz / Village Council: Damanhur / El Abaadia

Team: Colin Demars and Kareem Hassan

Interviewed*:* Zaghlool Abdelgawad El-Seadawy (Sheikh El-Balad): 01094120472

Status: not selected

General characteristics

- There are around 1000 inhabitants in the villages.
- Village really poor, people do not own land. Most villagers are working in the building construction. Sheikh el balad complained about health problem in the village.
- Six children died recently in the open drainage channel. The first contact in the village was not easy.

Sanitation

- The village is served by an informal sewer network. The construction was built 25 years ago; it was supervised by a freelancer. Some open manholes were observed. The network is clogged 1 time per month.
- 5 main lines (20 cm concrete pipes), 50 houses per line. All discharging in the drain crossing the village.

Drinking Water

- **The village not connected with the public water station**. Every single house has its groundwater private pump. The drinking water is taken a public tap.

	Village	El Ashara	El Hamamee	Kabeel	M. Nassar	Haderi	K. Nuss
General Characteristics	**Latitude**	31°10'15.20"N	31° 5'40.02"N	31° 5'34.40"N	31° 5'10.99"N	31°10'21.62"N	31°10'43.60"N
	Longitude	30°22'2.40"E	30°20'48.81"E	30°24'54.42"E	30°23'57.95"E	30°20'47.61"E	30°14'7.10"E
	Population(2006)	2’252	730	1’762	1’854	1’450	3’000 (estimation)
	Main occupation	Farmers	Farmers (not owners of land)	Farmers and employees	Farmers and workers	Farmers	Mostly farmers
	Density of housing	Smaller than usual	Very high	Dense old part, new sparser part developing around	2 floors	Not dense, wide streets	Dense with up to 3-storey buildings
	Industry	No	No	No	One chicken farm	No	Milk factory
	Proximity to bigger town	No	Yes	Yes	Yes	No	No
	Proximity to water body	Village built on the bank of small canal	Village built on the bank of Mahmudeya Canal	Village surrounded by small canal and drain	Village surrounded several canals, incl. Mahmudeya	Village cross by a canal	Canal cross the village
	Water supply	Frequent interruption, low pressure	Good	Low pressure in higher floors	Good, but old pipes	Good but low pressure	Low pressure, need pump systematically
	Public buildings	3 mosques, 2 schools, 1 health center	None	None (mosque under construction)	3 mosques, 1school, 1 health center	3 mosques, 2 schools	1 school
Current Sanitation Practices	**Conveyance / Storage**	*Bayaras*	Informal sewer network	Both bayaras and inf. sewers	Inf. sewer network, dis-charging in canal	*Bayaras*	Both bayaras and inf. sewers
	Treatment	NO	NO	NO	No	No	No
	Disposal	Muzlaf Abu Ruslan Drain	Drain	Bakr Drain	Canal	Drain	Drain
	Stormwater	On the streets to evaporate					
	SWM	NO	Collection by VC truck	NO			
	Manure Handling	Separate collection of solid (transferred to fields) and liquid part (either in sanitation system or discharged in canal/drain/streets)					
	Distance from drain	400 m	Right outside the village	Right outside the village	1km	Right outside the village	1km out of the village
	Problems with current situation	Not enough trucks for emptying -> flooding, expensive	Frequent clogging of the network and need for maintenance	Frequent clogging and flooding of sewer network	Frequent clogging	Bayaras overflowing	Frequent clogging
Organization and awareness	**Past/ongoing projects**				Just rebuild one network		Built a sewer network xx years ago
	Community's organization	CDA for charity & Agricultural Association	No CDA, no *omda*, Dmesna should be responsible				Sewer maintenance Charity assoc.
	Community's awareness	People seem worried and interested in finding a solution	People motivated for solution, willing to pay	Will for a plant			
	Support at higher level	Sheikh supportive and respected in the village.	According to people there is none. Omda rather indifferent	*Omda* very friendly and usually supportive			
Master Plan		Phase 3	-	Phase 6			
Comments		Both head and secretary of the Besentway VC very helpful and well informed	Very dense village with friendly and interest people.	*Omda* ready to give away land for a WWTP			Built on a hill

ESRISS Project

www.sandec.ch/esriss

Interview Guide for Village Authorities and Representatives

دليل المقابلة مع المسؤلين فى القرية

- First Contact Visit أول زيارة–

Team members: Philippe Reymond, Colin Demars and Mohamed Hassan Tawfik

أعضاء الفريق: فيليب ريمون- كولين ديمارس- محمد حسن توفيق

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Materials: semi-structured interview for village authorities, detailed satellite images of the village (from Google Earth).

Rationale of the study الهدف من وراء هذة الدراسة

ESRISS project is an **applied research project** led by the **Swiss Research Institute for Water and Wastewater** aiming to support the Egyptian Holding Company for Water and Wastewater (HCWW) in the development of sustainable and cost-effective rural sanitation. Until now there is no clear strategy for sanitation in isolated ezbas, and most initiatives in rural areas failed because of lack of understanding of the particularities of the Egyptian village.

هذا المشروع هوبحث تطبيقى يقوم بة مركز ابحاث سويسرى للمياة والصرف الصحى هدفة دعم الشركة القابضة المصرية للمياة والصرف الصحى لتطوير الصرف الصحى المستدام فى القرى , حتى ألان لايوجد أي استراتيجية واضحة للصرف الصحى فى العزب المعزولة , ومعظم المبادرات فى المناطق الريفية فشلت بسبب قلة فهم الاوضاع الخاصة للقرى المصرية .

The goal of our research is to develop improved wastewater management systems for ezbas. A good system should: اهداف هذة الدراسة

- collect and treat the wastewater properly تجميع ومعالجة مياة الصرف الصحى بصورة صحيحة
- improve the cleanliness and hygiene inside and around villages and reduce the pollution of drains, canals and groundwater resource
  تحسين النظافة داخل وحول القرى والحد من تلوث الترع والمصارف وموارد المياة الجوفية
- improve public health تحسين الصحة العامة
- reduce the amount of money that households have to pay currently to empty bayaras
  تخفيض التكاليف التى تتحملها كل أسرة من اجل تفريغ البيارات

This study should provide Egyptian decision-makers with a good basis for the design and implementation of sustainable and cost-effective sanitation systems for isolated rural areas.

هذة الدراسة من المتوقع ان تقدم اسس جيدة لصانعى القرار فى مصر من اجل تصميم وتنفيذ شبكات صرف صحى مستدامة تكون فعالة فى المناطق الريفية

Methodology المنهج المتبع (المنهجية)

Our study encompasses three components: هذة الدراسة تشمل ثلاثة مكونات

1. Assessment of past and on-going small-scale sanitation initiatives in rural areas in Egypt

   تقييم المبادرات السابقة والحالية للصرف الصحى على نطاق صغير فى المناطق الريفية فى مصر

2. Assessment of the situation of ezbas in the Nile delta, including needs of the communities, sanitation practices and characteristics of raw wastewater

   تقييم الوضع فى العزب الواقعة فى دلتا النيل, بما فى ذلك أحتياجات المجتمع , و الممارسات الصحية و خصائص مياة الصرف الصحى الخام

3. Development of scenarios, including technical proposal and management schemes.

   وضع السيناريوهات بما فى ذلك اقتراح التكنولوجيا ومخططات الادارة

In order to understand the existing situation and to develop our approaches we are studying some representative ezbas, with and without sewers.

من أجل استيعاب وفهم الوضع الحالى ولنكون قادرين على تطوير منهجنا , سوف نبدأ بدراسة عزبتان , واحدة منهم بها مجارى

To collect information, we will use the following tools:

والاخرى لايوجد بها , من اجل جمع المعلومات المناسبة سوف نستخدم الادوات التالية :

- Transect walks and observation المسح الشامل والملاحظة
- Interviews with key-stakeholders (omda, bayaraemptiers, farmers, person responsible for the sewer network, village council, NGOs (e.g. CDA), women associations, mosque caretaker, health centres) مقابلات مع الشخصيات المؤثرة والمسؤلة عن كل ما لة علاقة بالدراسة بداية من العمدة و المسؤلين عن القرية
- Household surveys دراسات منزلية (مقابلات مع اهالى القرية)
- Wastewater sampling and analyses اخذ عينات وتحليل مياة الصرف الصحى

Questionnaire for village authorities (omda / sheikh el balad) أسئلة للعمدة

1. How many inhabitants, how many households, how many buildings? ماعدد الاسر الموجودة؟ عدد السكان
2. **General sanitation situation:** الوضع الصحى العام
   a. bayaras and/or sewer system(s) ? يستخدم بيارة أم شبكة صرف
   b. Any problems linked to sanitation? هل هناك أى معوقات
3. Groundwater table منسوب المياة الجوفية
4. Location of **drains and canals** on the map تحديد الترع والمصارف على الخريطة

5. If there is a **sewer**: اذا كان هناك مجارى

    a. How many systems ? كم عدد الخطوط

    b. Identify the locations of the main lines and exit points on the map تحديدها على الخريطة

    c. How many households are connected? If not, why? كم عدد ألاسر الموصلة أليها ؟ اذا كان لا فلماذا ؟

    When was this system built and by whom? متى تم الأنشاء

    d. Cost per household – construction & maintenance? تكلفة كل أسرة بالنسبة للأنشاء و الصيانة

    e. Problems with the network(s) ? هل هناك مشاكل مع الشبكة

    f. What material for the pipe? ما الخامات المستخدمة فى ألانشاء

    g. Who is responsible for the maintenance (take the contact) ? (الصيانة) من المسؤل عن الحفاظ علية

If there are bayaras: اذا كان لايوجد مجارى

    a. Bayara emptiers: how many trucks, public/private, origin ? كم عدد عربات الكسح, وتابعة لأى جهة؟

    b. Contacts أرقام التليفون

    c. Location of disposal points (map) ماقع التخلص من مياة الصرف على الخريطة

    d. Frequency of emptying عدد مرات الكسح

    e. Cost for desludging (cost per trip , Is there any difference in the price according to the season?) ماهى تكلفة أزالة مياة المجارى وهل هناك أختلاف على حسب الموسم؟

    f. Price differences between public and private truck(s) فرق السعر بين العربات الخاصة و الحكومية؟

    g. What happens if someone cannot afford emptying? ماذا يحدث لو هناك شخص لا يستطيع الدفع

    h. Is there someone in the village who builds bayaras? هل هناك شخص يبنى البارات فى القرية

    i. Cost to build a bayara? ما هى تكلفة بناء بيارة

    j. How bayaras are constructed (permeable or not, lining, bottom, measures to improve infiltration)? كيف يتم أنشاء البيارات؟ (ألارضية,القاع,..)

    k. Do farmers use wastewater from the bayaras in their fields?

    هل يستخدم الفلاحون مياة الصرف من البيارات فى الحقول؟

6. Quality of drinking water supply network: pressure, quantity, quality; everybody connected?

    هل كل ألاسر موصلة لشبكة مياةالشرب ؟هل هى جيدة من حيث (ضغط المياة ,الكمية ,نوعية المياة)

7. What are the main professional occupations of the inhabitants? ماهى الوظائف الاساسية لمعظم السكان

8. Are there significant differences in the inhabitants' income and social status?

    هل هناك فرق واضح فى الدخل والمستوى المعيشى بين أهالى القرية؟

    If yes: what are the different categories? أذا كان الجزاب بـ "نعم" , ما هى الفئات المختلفة؟

9. Are there any community members who play a special role in this village?

    (Examples: leading an association, organizing special activities, religious leaders, etc.)

    هل هناك أىً من الافراد الذين يلعبون دورا خاصا فى القرية؟ (على سبيل المثال:تأسيس جمعيات,تنظيم أنشطة أجتماعية)

10. Are there NGOs in the village? A Water User Association?

    هل هناك منظمات غير حكومية فى القرية؟ او جمعية لمستخدمى المياة ؟

11. Is there a health centre?

    هل يوجد مركز صحى

12. Are there small industrial activities (e.g. milk factories, cattle and poultry farms)?

    هل يوجد انشطة صناعية صغيرة (البان؟)

13. How many animals does one household have on average? Do they live in the house, a separate building or outside?

    كم عدد الحيوانات التى تملكها الاسرة الواحدة (المتوسط) ؟هل تعيش هذة الحيوانات فى نفس المنزل أم فى مبنى منفصل؟

14. Do farmers use manure and animal urine in their fields?

    هل يتم استخدام روث الحيوانات فى الحقول؟

Ask for contact number

رقم تليفون العمدة أو أى شخص أخر يمكن الاتصال بةفى القرية

Transect walk اسئلة اثناء المسح الشامل

To be carried out with one or several village members.

Goal of the transect walk:

To get a first impression and understanding of

الحصول على الانطباع الاول وفهم :اهدافة:

- the current infrastructure and practices,

  البنية التحتية والممار اسات الحالية
- hot spots and problems related to wastewater management,

  البقع الساخنة والمشاكل المتعلقة بادارة المياة العامة
- requirements for sampling and measurements.

  المتطلبات لآخذ العينات والقياسات
- confirmation of the information collected during the interview and locations on the map

  تأكيد المعلومات التى تم جمعها أثناء الأستبيان و المواقع على الخريطة

Household Survey Questionnaire

الأستبيان الخاص بالأسر

Team members: Philippe Reymond, Anastasia Papangelou, Lukas Ulrich and Mohamed Hassan Tawfik

فريق العمل : فيليب ريمون , ناتاشا بابنجيلو , لوكس أولريش , محمد حسن توفيق

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

الأتصال بالسيد فيليب ريمون على الرقم و البريد الألكترونى المبين

Rationale of the study أهداف الدراسة

ESRISS project is an **applied research project** led by the **Swiss Research Institute for Water and Wastewater** aiming to support the Egyptian Holding Company for Water and Wastewater (HCWW) in the development of sustainable and cost-effective rural sanitation. Until now there is no clear strategy for sanitation in isolated ezbas, and most initiatives in rural areas failed because of lack of understanding of the particularities of the Egyptian village. هذا المشروع هو بحث تطبيقى يقوم بة مركز ابحاث سويسرى للمياة و الصرف الصحى هدفة دعم الشركة القابضة المصرية للمياة و الصرف الصحى لتطوير الصرف الصحى المستدام فى القرى,حتى ألان لا يوجد استراتيجية واضحة للصرف الصحى فى العزب المعزولة ,ومعظم المبادرات فى المناطق الريفية فشلت بسبب قلة فهم الاوضاع الخاصة للقرى المصرية

The goal of our research is to develop improved wastewater management systems for ezbas. A good system should اهداف هذة الدراسة

- collect and treat the wastewater properlyتجميع و معالجة مياة الصرف الصحى بصورة صحيحة
- improve the cleanliness and hygiene inside and around villages and reduce the pollution of drains, canals and groundwater resources تحسين النظافة داخل وحول القرى والحد من تلوث الترع و المصارف وموارد المياة الجوفية
- improve public health تحسين الصحة العامة
- reduce the amount of money that households have to pay currently to empty bayaras تخفيض التكاليف التى تتحملها كل أسرة من اجل تفريغ البيارات

This study should provide Egyptian decision-makers with a good basis for the design and implementation of sustainable and cost-effective sanitation systems for isolated rural areas. هذة الدراسة من المتوقع ان تقدم اسس جيدة لصانعى القرار فى مصر من اجل تصميم و تنفيذ شبكات صرف صحى مستدامة تكون فعالة فى المناطق الريفية

General methodology المنهج العام

Our study encompasses three components: هذة الدراسة تشمل ثلاثة مكونات

1. Assessment of past and on-going small-scale sanitation initiatives in rural areas in Egypt تقييم المبادرات السابقة و الحالية للصرف الصحى على نطاق صغير فى المناطق الريفية فى مصر
2. Assessment of the situation of ezbas in the Nile delta, including needs of the communities, sanitation practices and characteristics of raw wastewater تقييم الصرف الصحى الموجود بالعزب فى دلتا النيل, ويشمل حاجات المجتمع,ممارسات الصرف الصحى و خصائص مياة الصرف الصحى الخام
3. Development of scenarios, including technical proposal and management schemes. وضع السيناريوهات بما فى ذلك اقتراح التقنية ومخططات الادارة

In order to understand the existing situation and to be able to develop our approaches we will start by studying three representative ezbas (El Hamamee, El Ashara and Kabeel). To collect information about these villages, we will use the following tools: من أجل استيعاب و فهم الوضع الحالى ولنكون قادرين على تطوير منهجنا ,سوف نبدأ بدراسة ثلاث عزب,(الحمامى,العشرة,قابيل), من اجل جمع المعلومات المناسبة عن هذة القرى سوف نستخدم الادوات التالية

- Transect walks and observation المسح الشامل و الملاحظة
- Interviews with key-stakeholders (omda, bayara emptiers, farmers, person responsible for the sewer network, village council, NGOs (e.g. CDA), women associations, mosque caretaker, health centres) مقابلات مع الشخصيات المؤثرة و المسؤلة عن كل ما لة علاقة بالدراسة بداية من العمدة و المسؤلين عن القرية
- **Household surveys دراسات منزلية (مقابلات مع اهالى القرية)**
- Wastewater sampling and analyses اخذ عينات و تحليل مياة الصرف الصحى

For the household surveys in the three villages the questionnaire below will be used. من اجل الدراسات المنزلية فى الثلاث قرى سوف نستخدم الاستبيان (الاسئلة) الاتية:

Information for households participating in the survey معلومات للاسر المشاركة فى هذا الاستبيان

We are interested in learning about sanitation in your community. You are one of [#] people in this community who are being asked to answer a few questions to help us learn more. The responses you give will provide us with valuable information to understand sanitation issues in your community. This information will be used to make recommendations to improve sanitation. نحن مهتمون بمعرفة الاوضاع الصحية (المرافق الصحية) فى مجتمعك .انت واحد من عدد ( ) فرد يعيش هنا الذى طلب منة الاجابة على بعض الاسئلة لمساعدتنا على معرفة المزيد من المعلومات. ردك على هذة الاسئلة سوف يزودنا بمعلومات قيمة لفهم قضايا الصرف الصحى بمجتمعك.وسوف تستخدم هذة المعلومات لتقديم توصيات لتحسين الصرف الصحى.

What is expected from the respondent? ما هو المطلوب منك
We are asking you to help us complete a short questionnaire. Using the questionnaire we will ask you to answer questions about your household. The survey will take approximately 30 minutes to complete. نحن نطلب منك مساعدتنا على اكمال استبيان قصير.باستخدام الاستبيان سوف نطلب منك الاجابة على اسئلة حول اسرتك .هذا الاستبيان سوف ياخذ حوالى نصف ساعة.

Privacy, anonymity and confidentiality: الخصوصية و السرية و عدم الكشف عن الهوية
Please be assured that the information you provide will be treated in a confidential manner. Only investigators of this study will have access to the information collected. Your name will not be associated with the information you provide us. Instead, this questionnaire has been assigned a unique identifying number. You will not be personally identified in any reporting of data. All information collected will be combined and reported as a group. الرجاء التاكد من انة سوف يتم التعامل مع المعلومات التى تقدمها بطريقة سرية. القائمون على هذة الدراسة فقط هم من يسمح لهم الاطلاع على المعلومات التى تم جمعها .اسمك لن يكون موجود مع المعلومات التى تقدمها لنا.بدلا من ذلك سوف يتم استخدام رقم فريد.ولن يتم التعرف عليك شخصيا فى هذة البيانات .وسيتم الجمع بين جميع المعلومات التى تم جمعها وذكرت كمجموعة .

Future use of information: استخدام المعلومات فى المستقبل
This information may be used in the future for additional research on sanitation. We assure you that privacy, anonymity, and confidentiality will be maintained. يمكن استخدام هذة المعلومات فى المستقبل من اجل بحث اضافى عن الصرف الصحى.ونؤكد لك الخصوصية و السرية وعدم الكشف عن الهوية .

Right not to participate and withdraw: حق عدم المشاركة
Your participation is completely voluntary. You have the right to stop the survey at any time. مشاركتكم هى عمل تطوعى بالكامل ويمكنكم التوقف فى اى وقت.

Person to contact: شخص للاتصال بة
If you have any questions about your rights as a participant in this study, you may contact us (The contact number of Philippe Reymond, ESRISS project coordinator, is 0106 483 43 14). اذا كان لديك اى سؤال عن حقوقك فى المشاركة فى هذة الدراسة .يمكنك الاتصال بنا (منسق المشروع /فيليب ريموند 01064834314)

Do you have any questions? Do you agree to participate in this study? هل لديك اى اسئلة ؟هل توافق على الاشتراك فى هذة الدراسة؟

Person interviewed الشخص الذى تمت معة المقابلة		**Questionnaire no.** رقم الاستبيان	
Surname لقب		**Date** التاريخ	
Family Name اسم العائلة		**Start time**وقت البدء	
Household head? المسؤل عن الاسرة (كبير العائلة)		**End time** وقت الانتهاء	
Village القرية		**Duration** المدة	
Latitude خط العرض		**Interview completed?**تم استكمال المقابلة؟	
Longitude خط الطول		**Photo filenames**	

A	**HOUSEHOLD CHARACTERISTICS** خصائص المنزل		
1	**How many people live in this house/household?** كم عدد افراد فى هذا البيت ؟	**House** منزل	**Household** أسرة
	Total اجمالى العدد		
	Adults (18 and older) – men رجال		
	Adults (18 and older) – women سيدات		
	Childrenاطفال		
2	**What is the main occupation / source of income?**؟ مصدر الدخل,الوظيفة		
	Farmers فلاح		
	Shop owners(متجر) مالك محل		
	Workers (builders, plumbers…) عامل		
	Civil servants موظف خدمة مدنية		

3	**Which of the following appliances do you have in the house?** انواع الاجهزة الموجودة بالمنزل	
	Washing machine غسالة	
	Dishwasherغسالة صحون	
	Fridge ثلاجة	
	TVتلفزيون	
4	**[Do you have a toilet in the house?] What kind of toilet?** هل يوجد مرحاض؟مانوعة؟	
	Sitting or squatting? عادى أم قرفصاء	
	Pouring or flushing? يوجد سيفون أم لا	
5	***If flushing:*** **How much water do you use for flushing?** فى حالة وجود سيفون, كمية الماء المستخدم للتنظيف؟	
6	***If pouring:*** **How much water do you use for pour-flushing?** فى حالة عدم وجود سيفون, كمية الماء المستخدم للتنظيف؟	
7	**To what kind of ww collection system is your toilet connected to?** ما نوع الصرف الموصل الية	
	Sewer network شبكة صرف صحى	
	Bayara بيارة	
	Trench ترنش	
	Pipe directly to drain انابيب مباشرة الى المصرف	
8	***If no toilet in the house*****: what of the following do you practice?** فى حالة عدم وجود مرحاض داخل المنزل, ما هو الاجراء المتبع؟	
	Use neighbour's toilet استخدام مرحاض خاص بأحد الجيران	
	Use public toilet (mosque…) استخدام مراحيض عامة	
	Use of pot وعاء	
	Open defecation in the fields داخل الحقول	

B	**DRINKING WATER SUPPLY مياة الشرب**	
9	**Do you have a household connection for water supply?** هل يوجد توصيل لمياة الشرب داخل المنزل	
	If not skip questions 10-13 and 22-24 *فى حالو الأجابة بـ لا توجة للسؤال 22 و 24*	
10	**How many taps are there in the house?** كم صنبور ماء داخل المنزل	
11	**Do you know how much water you use in your household ? Are there seasonal variations?** كمية الماء المستخدم داخل المنزل ؟ و هل تختلف فى مواسم او اوقات معينة؟	
12	**Are there any kinds of problems with the water supply?** هل يوجد مشاكل فى امداد الماء	
13	***If yes:* what kinds of problems?** فى حالة "نعم" ما هى هذة المشكلات	
	Interruptions (when?) قطع؟متى؟	
	Low pressure (when?)do use an engine to pump it ? ضغط ضعيف؟ متى؟ هل تستخدم موتور لرفع المياة؟	
	Bad taste, smell رائحة او طعم سىء	
14	**Do you use different sources of water for different uses (communal tap, well, canal…)?** هل تحصل على الماء من مصادر مختلفة ؟من اجل استخدامات مختلفة؟	
	If no (only tap water is used for everything), jump to 21	
15	***If yes:* Why ?** لماذا ؟ فى حالة "نعم"	
16	**Which sources for each of the following uses ?** ما هى المصادر ؟	
	Drinking water مياة الشرب	
	Cooking water مياة الطهو	
	Dishwashing water مياة غسل الصحون	
	Bathing water مياة الاستحمام	
	Laundry water مياة غسل الملابس	

17	**Who is responsible for bringing the water home?** من المسؤل عن احضار الماء للمنزل	
18	**How far is it from the house?** كم تبعد المسافة ؟	
19	**How often do you go?** ما هى عدد مرات الذهاب	
20	**What kind of vessel do you use?** ما هو الوعاء المستخدم لآحضار الماء	
21	**Any household water treatment system (e.g. filter, chlorination,…) ? Do you use a vessel for storing drinking water?** ماذا تستخدم لتخزين مياة الشرب؟ هل تتم معالجة المياة داخل المنزل؟	
22	**Are you paying a bill for the water? Is someone regularly coming to measure the water consumption at your water meter? How frequently?** هل تدفع فاتورة المياة ؟هل ياتى احد لقراءة العداد ومعرفة الاستهلاك بانتظام ؟كل كم من الوقت ؟	
23	***If yes:* How much on average you pay per month?** لو "نعم" ما هو متوسط قيمة الفاتورة كل شهر	
	In the summer فى الصيف	
	In the winter فى الشتاء	
24	**Do you think you receive a good level of service in exchange of what you are paying?** هل تتلقى خدمة مناسبة فى مقابل دفع فاتورة المياة ؟	

C	**GREYWATER [These questions should be answered by a woman]** **المياة الرمادية (هذة الأسئلة يفضل ان يتم الأجابة عليها عن طريق سيدة)**	
25	**Laundry** غسيل الملابس	
	Vessel (manual) / Washing machine / Canal يدوى/ غسالة/ الترعة	
	Volume of vessel / washing machine حجم الوعاء أو الغسالة	
	Frequency / Loads [times/week, loads/time] عدد المرات فى الأسبوع	
	Discharged in bayara / sewer / canal, drain / street يتم التخلص من المياة فى : المجارى/ الترعة أو المصرف/ الشارع	

	Those figures are for the whole house or for one household? هذة المعلومات تنطبق على المنزل كلة أم أسرة واحدة؟	
26	**Dishwashing** غسيل الصحون	
	Sink / vessel الحوض / وعاء	
	Volume of vessel (measurement) حجم الوعاء	
	Frequency (times/day) عدد المرات فى اليوم	
	Discharged in bayara / sewer / canal, drain / street يتم التخلص من المياة فى : المجارى/ الترعة أو المصرف/ الشارع	
	Those figures are for the whole house or for one household? هذة المعلومات تنطبق على المنزل كلة أم أسرة واحدة؟	
27	**Showering** الأستحمام	
	Frequency (summer) : men / women/ children (times/week) عدد المرات (فى الصيف) : رجال / نساء / أطفال [عدد المرات فى الاسبوع]	
	Frequency (winter) : men / women/ children (times/week) عدد المرات (فى الشتاء) : رجال / نساء / أطفال [عدد المرات فى الاسبوع]	
	Mean duration متوسط المدة	
	Water discharged in bayara / sewer / canal, drain / street يتم التخلص من المياة فى : المجارى/ الترعة أو المصرف/ الشارع	
28	**Which chemical products do you use (for laundry, cleaning, dishwashing, handwashing…)?** *ما المواد الكيماوية المستخدمة فى (غسل الملابس,التنظيف,غسل الصحون,غسل اليدين)*	
29	**How many units do you use per month (bottles, soap bars, bags, boxes…)?** *ما هو الاستهلاك الشهرى ؟*	

D1	**BLACKWATER – SEWERS** **المجارى(المياة السوداء)**	
30	**For how long have you had sewer connection?** منذ متى لديك وصلة مجارى؟	
31	**What type of sewers are they? (deep/shallow, diameter, material, real sewers or perforated drains to lower groundwater table?)** ما هو نوع الصرف المستخدم ؟	

32	**Does the wastewater directly go to the sewer or does it flow through a bayara first?** هل مياة الصرف تذهب الى المجارى مباشرة ام الى البيارة ثم الى المجارى؟هل الوصلة مباشرة الى المجارى ام الى البيارة اولا و هذة البيارة موصلة الى شبكة المجارى؟	
33	**Do you face any problems with the network?** هل تواجة اى مشكلات مع شبكة الصرف	
34	**If yes: What kind of problems? (open ended)** ما نوع هذة المشكلات **When do most problems occur? How often?** متى تحدث هذة المشكلات	
35	**Is there someone responsible for the maintenance of the sewers?** هل هناك احد مسؤل عن صيانة المجارى؟ ***If yes*: Who?** ***If no*: How do you deal with the problems?** فى حالة "نعم" من؟ فى حالة "لا" من يتعامل مع مشاكل المجارى؟	
36	**Are the sewers connected to a wastewater treatment plant?** هل شبكات المجارى موصلة بمحطة معالجة؟	
37	**Do you know if there are any plans to connect?** هل لديك معلومات اذا كان هناك مخطط لتوصيلها ؟	
38	**Did/Do you pay for** هل تدفع مقابل	
	the household connection? How much? التوصيل للمنزل؟ كم؟	
	the main sewer? How much? المجارى الرئيسية؟ كم	
	the maintenance of the main sewer (monthly or per event) ? تصليح الخط الرئيسى (فى الشهر أو حسب العطل)	

D2	**BLACKWATER – BAYARAS** البيارات	
39	**How is the bayara designed?** ما هو تصميم البيارة	
	Material of the walls? Permeable or not? من اى مادة تم صنع حوائط البيارة ؟ و هل هى مادة تساعد على نفاذ المياة منها؟	
	Is the bottom sealed or not? قاع البيارة مبنى ام لا ؟	
	Is there a draining layer (eg with gravel, stones…) ? هل يوجد طبقة استنزاف	

	Where does infiltration/exfiltration take place?اين يحدث التسريب او عكسها؟	
40	**What are the dimensions of the bayara? Can you show them to us?** ما هى ابعاد البيارة ؟ ممكن ان نراها؟	
41	**How often is the bayara emptied? Are there seasonal variations?** كم مرة يتم افراغ البيارة؟ هل هناك اختلاف على حسب الموسم؟	
42	**How do you find out that the bayara is full/needs emptying?** كيف تعرف ان البيارة قد امتلآت	
43	**How is the bayara emptied?** كيف يتم افراغ البيارة	
	Mechanically by trucks عن طريق عربات الكسح	
	Mechanically + manually combined يدوى	
44	**How many trucks are filled on average each time? Is the bayara emptied completely each time, including sludge?** كم عدد العربات هل يتم ازالة الحماءة (الرواسب من القاع) المستخدمة لآفراغ البيارة ؟ هل يتم افراغ البيارة بالكامل كل مرة ؟	
45	**How do you organize emptying?** كيف يتم تنظيم افراغ البيارة	
	Phone call بمكالمة تليفون	
	Contract (emptier comes regularly) عقد بمواعيد ثابتة لتفريغ البيارة	
	Other (specify) طرق اخرى	
46	**Where does the sludge from the bayara end up to?** اين يتم التخلص من الحمأة(الوحل-الرواسب) بعد افراغ البيارة	
	Drain فى المصرف	
	Reused in fields يعاد استخدامها فى الحقل	
	Other? طرق اخرى	
47	**Who owns the trucks for emptying the bayara?** من يملك عربات التفريغ	
	CDA منظمات تنمية المجتمع المحلى	
	Village council ? المركز	
	Private خاصة	

48	**How much do you pay per emptying?** كم تدفع مقابل افراغ البيارة	
	For CDA/V.C. trucks للعربات التابعة لمنظمات المجتمع المحلى	
	For private trucks للعربات الخاصة	
49	**Do you face any problems with the bayaras?** هل تواجة مشكلات مع البيارة	
50	**If yes: what kind of problems? (open ended)** ما نوع هذة المشكلات	
51	**When do most problems occur?** متى تحدث غالبا	
52	**Do you do something to reduce the emptying frequency? What?** هل تقوم بفعل شيء من اجل تقليل مرا ت افراغ البيارة ؟ ماذا تفعل؟	

E	**ANIMALS – MANURE [Explain relation to wastewater management]** **روث الحيوانات [وعلاقة بالبحث]**	
53	**How many animals of the following species do you have?** كم عدد الحيوانات التى تملكها من الانواع الاتية	
	Cattle (Cows/ Buffalos) بقر	
	Sheep خراف	
	Goats ماعز	
	Donkeys حمير	
	Poultry دواجن	
	If no animals, jump to 62 فى حالة عدم وجود مواشى أنتقل الى السؤال رقم	
54	**How often are the animals in the fields? For how long?** كم عدد المرات التى يتواجد بها الحيوانات فى الحقول ؟ وما المدة؟	
55	**How are you handling the manure? Is there a seasonal variation? (If yes, explain)?** كيف تتعامل مع روث الحيواناتو هل يختلف على حسب الموسم؟ شرح؟	
	a. Solid part: الجزء الصلب	
	b. Liquid part *الجزءالسائل*	
	Type and size of vessel/ tank نوع الوعاء و حجمة	

	Frequency of emptying عدد مرات أفراغة	
	Discharged in bayara / sewer/ canal or drain / street / fields يتم التخلص منة فى : البيارة / المجارى/ الترعة أو المصرف/ الشارع	
56	**Is the floor of the stable naked concrete or covered with straw? Something else?** هل ارضية الزريبة مغطاة بالخرسانة/القش(التبن)؟ ام مادة اخرى؟	
57	**How often do you clean the stable?** كم مرة يتم تنظيف الزريبة ؟	
58	**How? (Transportation of manure: type of container and frequency)** كيف يتم نقل الروث؟وكم مرة ؟وما نوع الوعاء المستخدم فى نقلة؟	
59	**Do you use water for cleaning?** هل تستخدم مياة فى التنظيف؟	
60	**How are you reusing the manure?** كيف تعيد استخدام الروث ؟	
	In the fields؟ فى الحقول	
	As a fuel؟ كوقود	
	Other? طرق اخرى	
61	**If applied on fields: How far is the field from the village?** كم تبعد مسافة الحقل؟فى حالة استخدام الروث فى الحقول	
F	**INSTITUTIONAL - ORGANISATIONAL ASPECTS** الجزء التنظيمى	
62	**Who is responsible for** من المسؤل عن	
	Solid waste collection? تجميع النفايات الصلبة؟	
	Sweeping of the streets? كنس الشوارع ؟	
	Maintenance of sewers? المحافظة على المجارى	
	Emptying of the bayaras? افراغ البيارات	
63	**Do you pay a monthly fee for one of these services? How much? How is it collected?** هل تدفع فاتورة شهرية مقابل واحدة من هذة الخدمات ؟ كم تدفع؟كيف يتم جمع الفاتورة ؟	
	Solid waste collection? تجميع النفايات الصلبة؟	
	Sweeping of the streets? كنس الشوارع ؟	
	Maintenance of sewers? المحافظة على المجارى	
	Emptying of the bayaras? افراغ البيارات	

64	**Do you think the CDA/village council is useful/ affects positively the community?** هل تظن ان جمعية تنمية المجتمع/مجلس القرية مفيد للمجتمع ؟	
65	**What does the CDA/village council do well?** ما الذى يقوم بة مجلس القرية /تنمية المجتمع بشكل جيد؟	
66	**What does the CDA/village council do bad, space for improvement?** ما الذى يقوم بة مجلس القرية/تنمية المجتمع ,بشكل سىء ؟	
67	**Do you think the CDA/village council should provide more services? Which ones** هل تظن ان جمعية تنمية المجتمع /مجلس القرية يجب ان يقدموا خدمات اكثر ؟ما هى هذة الخدمات ؟	
68	**Are there any other organizations active in the village? (religious, social…)** هل هناك اى منظمة فعالة فى القرية	
69	**What is the role of each of them?** ما هو الدور لكل منظمة	
70	**Who do you turn to if there is a problem with water ?** من الذى تتوجة الية فى حالة وجود مشكلة خاصة بالمياة	
71	**Would you allow us to come to your household again to quantify water use and wastewater characteristics, and to study the bayara?** و رؤية البيارة ؟هل تسمح لنا بزيارة منزلك لتقييم وضع المياة و مياة الصرف	

ESRISS Research Project
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Household Survey Questionnaire

MFA version

استبيان (اسئلة) للدراسات المنزلية (اسئلة للاهالى)

Team members: Philippe Reymond, Colin Demars and Mohamed Hassan Tawfik

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Person interviewed		**Questionnaire no.**	
Surname لقب		**Date** التاريخ	
Family Name اسم العائلة		**Start time** وقت البدء	
Household head? المسؤل عن الاسرة (كبير العائلة)		**End time** وقت الانتهاء	
Coordinates احداثيات		**Duration** المدة	
Latitude		**Interview completed?** تم استكمال المقابلة؟	
Longitude		**Photo filenames**	

A	**HOUSEHOLD CHARACTERISTICS**		
1	**How many households are there in this house?** كم عدد الأسر فى المنزل؟		
2 *	**How many people live in this house?** كم عدد افراد فى هذا البيت ؟	**House**	**Household***
	Total اجمالى العدد		
	Adults (18 and older) – men رجال		
	Adults (18 and older) – women سيدات		
	Children (Boys / girls) اطفال		
3	**What is the main occupation / source of income**? مصدر الدخل,الوظيفة ؟		
	Farmers فلاح		
	Shop owners مالك محل (متجر)		
	Workers (builders, plumbers...) عامل		
	Civil servants موظف خدمة مدنية		

4	*	**[Do you have a toilet in the house?] What kind of toilet? How many?** هل يوجد مرحاض؟مانوعة؟	
		Sitting or squatting? أفرنجى / بلدى	
		Pouring or flushing? سيفون/ لا يوجد	
5	*	***If flushing:* Can we measure the dimensions of the tank?** هل يمكن قياس حجم السيفون	
6	*	**To what kind of ww collection system is your toilet connected to?** ما نوع الصرف الموصل الية**?**	
		Sewer network شبكة صرف صحى	
		Bayara / Trench بيارة	
		Pipe directly to drain انابيب مباشرة الى المصرف	

B	**DRINKING WATER SUPPLY مياة الشرب**	

7	*	**How many taps are there in the house? *How many water meters?** كم صنبور ماء داخل المنزل	
8		**Are there any kinds of problems with the water supply?** هل يوجد مشاكل فى امداد الماء	
9		***If yes:* what kind of problems?** فى حالة "نعم" ما هى هذة المشكلات	
		Interruptions (when?) قطع؟متى؟	
		Low pressure (when?)do use an engine to pump it? ضغط ضعيف؟ متى؟ هل تستخدم موتور لرفع المياة؟	
		Bad taste, smell رائحة او طعم سىء	
10		**Are you paying a bill for the water? Is someone regularly coming to measure the water consumption at your water meter? How frequently?** هل تدفع فاتورة المياة؟ هل ياتى احد لقراءة العداد ومعرفة الاستهلاك بانتظام؟كل كم من الوقت ؟	
11	*	**How much on average you pay per month?** (Take the reading of the water bill and see it if possible) لو "نعم" ما هو متوسط قيمة الفاتورة كل شهر	
		In the summer فى الصيف	
		In the winter فى الشتاء	

C	GREYWATER [These questions should be answered by a woman]	
12 *	**Laundry** غسيل الملابس	
	Vessel (manual) / Washing machine / Canal يدوى/ غسالة/ الترعة	
	Volume of vessel / washing machine (measurement) حجم الوعاء أو الغسالة	
	Frequency (times/week) عدد المرات فى الأسبوع	
	Discharged in bayara / sewer / canal, drain / street يتم التخلص من المياة فى : المجارى/ الترعة أو المصرف/ الشارع	
	Those figures are for the whole house or for one household? هذة المعلومات تنطبق على المنزل كلة أم أسرة واحدة؟	
13 *	**Dishwashing** غسيل الصحون	
	Sink / vessel الحوض / وعاء	
	Volume of vessel (measurement) حجم الوعاء	
	Frequency (times/day) عدد المرات فى اليوم	
	Discharged in bayara / sewer / canal, drain / street يتم التخلص من المياة فى : المجارى/ الترعة أو المصرف/ الشارع	
	Those figures are for the whole house or for one household? هذة المعلومات تنطبق على المنزل كلة أم أسرة واحدة؟	
14 *	**Showering** الأستحمام	
	Mean frequency متوسط عدد المرات	
	Mean duration متوسط مدة الأستحمام	
	Water discharged in bayara / sewer / canal, drain / street يتم التخلص من المياة فى : المجارى/ الترعة أو المصرف/ الشارع	

D1	**BLACKWATER – SEWERS** **المجارى**	
15 *	**Do you have bayaras or sewer to collect wastewater?** (only one system or both) هل لديك بيارة أم موصل لشبكة صرف؟ (هل لديك نظام واحد أم أثنين)؟	
	If only bayaras: go to question D2 *أذا كانت ببيارة فقط*	
16	**For how long have you had sewer connection?** منذ متى لديك وصلة مجارى؟	
17	**What type of sewers are they? (deep/shallow, diameter, material, real sewers or perforated drains to lower groundwater table?)** ما هو نوع الصرف المستخدم ؟	
18	**Do they flow through a manhole first?** هل هناك غرف تفتيش؟	
19	**How many sewers are they in the village?** كم عدد شبكات الصرف فى القرية؟	
20	**Did/Do you pay for** هل تدفع مقابل	
	the household connection? How much? التوصيل للمنزل؟ كم؟	
	the main sewer? How much? المجارى الرئيسية؟ كم	
	the maintenance of the system sewer? الصيانة؟	
21	**Do you face any problems with the network**? هل تواجة اى مشكلات مع شبكة الصرف	
22	***If yes*: What kind of problems? (open ended)** ما نوع هذة المشكلات **When do most problems occur? How often?** متى تحدث هذة المشكلات	

D2	**BLACKWATER – BAYARAS** **البيارات**	
23 *	**How is the bayara designed**? ما هو تصميم البيارة	
	*Material of the walls? Permeable or not? من اى مادة تم صنع حوائط البيارة ؟ وهل هى مادة تساعد على نفاذ المياة منها؟	
	*Is the bottom lined or not? قاع البيارة مبنى ام لا ؟	
	*Is there a draining layer (eg with gravel, stones…) ? هل يوجد طبقة استنزاف	

		Where does infiltration/exfiltration take place? اين يحدث التسريب او عكسها؟	
24	*****	**What are the dimensions of the bayara? Can you show them to us?** ما هى ابعاد البيارة ؟ ممكن ان نراها؟	
25	*****	**How often is the bayara emptied? Are there seasonal variations?** كم مرة يتم افراغ البيارة؟ هل هناك اختلاف على حسب الموسم؟	
26		**How is the bayara emptied?** كيف يتم افراغ البيارة	
		Mechanically by trucks عن طريق عربات الكسح	
		Mechanically + manually combined يدوى	
27	*****	**How many trucks are filled on average each time? What is the volume of these trucks?** كم عدد العربات التى تمتلىء فى كل مرة؟ وما هو حجمها؟	
28	*****	**Is the bayara emptied completely each time, including sludge?** هل يتم أفراغ محتوى البيارة فى كل مرة بالكامل بما فيها الحمأة؟	
29	*****	**Where does the sludge from the bayara end up to?** اين يتم التخلص من الحمأة(الوحل-الرواسب) بعد افراغ البيارة	
		Drain فى المصرف	
		Reused in fields يعاد استخدامها فى الحقل	
		Other? طرق اخرى	
30		**How much do you pay per emptying?** كم تدفع مقابل افراغ البيارة	
		For CDA/V.C. trucks للعربات التابعة لمنظمات المجتمع المحلى	
		For private trucks للعربات الخاصة	
31		**Do you face any problems with the bayaras?** هل تواجة مشكلات مع البيارة	
32		If yes: what kind of problems? (open ended) ما نوع هذة المشكلات	
33		**When do most problems occur?** متى تحدث غالبا	
34		**Do you do something to reduce the emptying frequency? What?** هل تقوم بفعل شىء من اجل تقليل مرا ت افراغ البيارة ؟ ماذا تفعل؟	

E	ANIMALS – MANURE [Explain relation to wastewater management]	
35 *	**How many animals of the following species do you have?** كم عدد الحيوانات التى تملكها من الانواع الاتية	
	Cows بقر	
	Sheep خراف	
	Goats ماعز	
	Donkeys حمير	
	Poultry دواجن	
36 *	**How often are the animals in the fields? For how long?** ما المدة التى تقضيها المواشى فى الحقل؟	
37 *	**How are you handling the manure? Is there a seasonal variation? (If yes, explain)** كيف تستخدم روث المواشى؟ هل هناك أختلاف على حسب الموسم؟	
	a. Solid part: الجزء الصلب	
	b. Liquid part: الجزء السائل	
	*Type and size of vessel/tank نوع وحجم الوعاء	
	*Frequency of emptying عدد مرات أفراغ الروث	
	*Discharged in bayara / sewer / canal, drain / street / fields يتم التخلص منة فى : البيارة / المجارى / الترعة أو المصرف / الشارع / الحقل	
38 *	**Is the floor of the *stable* naked concrete or covered with straw? Something else?** هل ارضية الزريبة مغطاة بالخرسانة/القش(التبن)؟ ام مادة اخرى؟	
39	**Do you use water for cleaning?** هل تستخدم مياة فى التنظيف؟	
40 *	Where do you get drinking water for animals (Public tap, HH tap)? How many litres per day? Is there any seasonal variation? (If yes? Explain) من أين تأتى بمياة الشرب للمواشى؟(من المنزل أم من مياة عمومية)؟ كم لتر فى اليوم؟ هل هناك أختلاف على حسب الموسم؟	
	Reading in the water meter: قرأة عداد المياة	

Interview Guide for Bayara Emptiers

الأستبيان الخاص بعمال الكسح

Team members: Philippe Reymond, Colin Demars and Mohamed Hassan Tawfik

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Bayara emptier interviewed العامل الذى تمت المقابلة معة		**Questionnaire no.** رقم الأستبيان	
Surname لقب		**Date** التاريخ	
Family Name اسم العائلة		**Start time** وقت البدء	
Village القرية		**End time** وقت الانتهاء	
Latitude خط عرض		**Duration** المدة	
Longitude خط طول		**Photo filenames**	

	General questions	
1	Since how long have you been doing this activity? منذ متى تقوم بهذا العمل	
2	Is it your only job or do you have other activity? هل هو عملك الوحيد ام تقوم بشىء اخر	
3	Do you only work in this village? هل تعمل فى هذة القرية فقط؟	
	If yes go to question 6 اذا كان نعم انتقل الى السؤال رقم	
4	How many villages are you serving? كم عدد القرى التى تقوم بالعمل فيها	
5	How frequently (times per month) are you working in this village? كم مرة فى الشهر تعمل فى هذة القرية	
6	Does the frequency of your visits vary with seasons? هل تختلف عدد المرات حسب الموسم؟	
7	Are you coming regularly or upon request? هل تاتى بانتظام ام على حسب الطلب ؟	
8 *	How many hours do you work per day usually? كم عدد ساعات العمل فى اليوم ؟	
9 *	How many working days per week? كم عدد أيام العمل فى الأسبوع؟	
10 *	What is the distance between the village and the emptying point? كم تبلغ المسافة بين القرية ومكان أفراغ النقلة؟	
11 *	How many trips do you manage to do per day usually? كم عدد النقلات التى تقوم بها فى اليوم الواحد عادة؟	

12	Do you own the truck? هل انت مالك العربة	
13	If “No” Whom does it belong to (Village Council, CDA,...) ? لو لآ, هل هى تابعة لجمعيات التنمية المحلية ؟	

	Financial questions (if private truck)	
14	How much do you charge for one trip? Fixed price? If not, how do you determine the price? كم تتقاضى مقابل النقلة الواحدة ؟ سعر ثابت ؟ أم لا , وكيف تحدد السعر فى هذة الحالة؟	
15 *	How much did you pay for the truck when you bought it? When was it? ما هو ثمن الجرار عند شرائة؟ منذ متى أشتريتة؟	
16 *	How much did you pay for the cistern when you bought it? When was it? ما هو ثمن الفنطاس عند شرائة؟ منذ متى أشتريتة؟	
17 *	How much did you pay for the pump when you bought it? When was it? ما هو ثمن ماتور الكسح عند شرائة؟ منذ متى أشتريتة؟	
18 *	What is the life-expectancy for the truck? ما هو العمر الأفتراضى للجرار؟	
19 *	How much fuel do you use per day usually? ما هى كمية الوقود المستهلك فى اليوم(فى المعتاد)؟	
20 *	How much do you pay for fuel consumption per day usually? ما هى تكلفة الوقود المستخدم فى اليوم؟(فى المعتاد)	
21	How much do you have to spend for the O&M of your truck? كم تدفع مقابل الوقود, العمال, ادارة ؟ What is your benefit at the end of the month? ما هوالربح الشهرى Do you think that this business is a good business? هل هى وظيفة او عمل جيد	

	Volume and discharge point	
22 *	Where do you dispose the sludge from the bayaras? اين تتخلص من الحمأة	
	Drain (Name - distance to disposal point) (اسم المصرف – المسافة) فى المصرف	
	Fields (type of crops?) فى الحقول (انواع المحاصيل)	
	Sewer network شبكة مجارى	
	If only drain or sewers jump to q. 20 اذا كان فى المجارى او مصرف فقط انتقل الى السؤال رقم	
23 *	What is the ratio trips to field/ trips to drain? كم عدد المرات الى الحقل او المصرف	
24	Do people pay you something to dispose on their fields? هل يدفع لك الناس لكى تفرغ الحمولة ففى حقولهم	
25	Do you see any problems with this emptying practice ? هل هناك صعوبات فى عملية تفريغ البيارات	
26 *	What is the volume of the truck? حجم العربة ؟	
27 *	Do you empty the bayaras completely (including sludge)?	

	هل تفرغ كل محتويات البيارة بما فيها الحمأة؟	
28	Do you empty the bayaras of the Mosque, the School or the heatlh center of the village?	
29 *	How many trips do you need to empty the bayara of كمم عدد التقلات لكى تفرغ البيارة الخاصة بـ	
	The mosque المسجد	
	The school المدرسة	
	The health center الوحدة الصحية	
30 *	How often do you empty: لكم من الوقت تعمل فى	
	The mosque المسجد	
	The school المدرسة	
	The health center الوحدة الصحية	

	Other questions (if spare time)	
31	Do you have a written record of the number of trips you make? هل لديك سجل لعدد النقلات التى تقوم بها ؟	
32	Do you have enough work? Do you have a lot of concurrence? هل لديك عمل كافى؟ هل لديك زحام	
33	How many other emptiers are working in the same village? كمم عدد العاملين بهذا المجال فى نفس القرية How many people are involved in the business ما هو عدد أصحاب عربات الكسح	
34	Do you experience any problems while emptying (e.g. clogging of your hose by solid waste or soil, thickened sludge,...) هل تواجة مشاكل اثناء الكسح ؟	
35	How would you characterise the content of bayaras (thick, liquid, layers) ما هى خصائص محتويات البيارة (كيف تصنفهاــ سائل – طبقات مختلفة؟)?	
36	Do you see a difference in the content of bayaras between summer and winter? هل هناك فرق فى محتوى البيارات فى الصيف و الشتاء ؟	
37	Any problem to access the houses? صعوبات للوصول الى المنازل	
38	Do you know about manual emptiers? هل تعرف عن عمال تفريغ يدوى	
39	Did you have any problems with the authorities or the police? هل لديك اى صعوبات مع السلطات	
40	Would you mind if we accompany you on one of your tours to understand your activity better? هل تسمح باصطحابنا معك اثناء احدى الزيارات	

Interview Guide for Sewer Operators

أستبيان خاص بعمال الصرف الصحى

Team members: Philippe Reymond, Colin Demars and Mohamed Hassan Tawfik

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Sewer operator interviewed العامل الذى تمت المقابلة معة		**Questionnaire no.** رقم الاستبيان	
Surname لقب		**Date** التاريخ	
Family Name اسم العائلة		**Start time**وقت البدء	
Village القرية		**End time** وقت الانتهاء	
Latitude خط عرض		**Duration** المدة	
Longitude خط طول		**Photo filenames**	

1	Since when have you been responsible for the maintenance of the sewer/drainage system? منذ متى وانت مسؤل عن صيانة المجارى /نظام الصرف؟	
2	Is it your only job or do you have other activities? هل هذة مهنتك الوحيدة ام لديك مهنة اخرى	
3	In which year was this sewer system installed? متى تم انشاء نظام الصرف الصحى	
4	How many households are connected? ما عدد المنازل الموصلة الية	
5	Where are the main lines located? اين تقع الخطوط الرئيسية	
6	Where is the water discharged? اين يتم التخلص من المياة	
7	What kinds of materials are the sewers made of? ما الخامات المستخدمة فى انشاءة	
8	What is the diameter of the pipes? ما هو قطر الانابيب	
9	What is the depth of the sewer lines? ما عمق خطوط المجارى	
10	Do the pipes have holes (i.e. perforated)? هل يوجد فتحات (ثقوب) فى الانابيب	
11	Are there any pumps, sedimentation tanks, manholes? هل يوجد مضخات , خزانات ترسيب , فتحات ؟	
12	How often do you do maintenance? كل كم من الوقت تقوم بالصيانة	
13	How many people are involved in the maintenance? كم عدد العمال المسؤلين عن الصيانة (القائمين على الصيانة)	
14	What do you do for maintenance and where do you access the system? ماذا تفعل من اجل الصيانة و كيف تدخل الى الشبكة (نظام الصرف)	
15	What tools do you use ? ما هى الادوات المستخدمة	

16	Are you coming regularly or upon request? هل تأتى بانتظام ام على حسب الطلب ؟	
17	Does the frequency of your work vary with seasons? هل تكرار الصيانة يختلف حسب المواسم	
18	What are the problems with the existing system? ما هى مشاكل النظام الحالى	
19	Where are the hot spots? اين الاماكن التى يوجد بها اكثر المشاكل	
20	What would you do to improve it? ماذا يمكنك فعلة لتحسين الوضع	
21	How much time do you usually need to solve a problem? كم من الوقت تحتاج لحل مشكلة فى نظام الصرف	
22	Who pays you? من يدفع لك مقابل عملك	
23	Who planned / designed / built this system? من قام بتخطيط /تصميم /بناء هذا النظام	
24	Does rain water go into the sewer system? If not, where does it go? هل تصل مياة الامطار الى شبكة الصرف؟ فى حالة "لآ" اين تذهب؟	
25	Do rain episodes generate problems? هل تحدث مشاكل بسبب فترات المطر	
26	Do you have problems with solids in the sewer system (mud, sand, solid waste, organic waste)? هل هناك مشاكل بسبب المواد الصلبة (طين- رمل - نفايات صلبة- نفايات عضوية)؟	
27	How was it financed? كيف تم تمويلة	
28*	Are there any plans of the sewer system? هل هناك اى خطط لنظام المجارى (الصرف الصحى)	
29*	What is the proportion of household connected to sewer/bayars?	
	ما هى نسبة المنازل الموصلة لشبكة المجارى و البيارة	

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Interview Guide for Farmers

أستبيان للمزارعيين

Team members: Philippe Reymond, Colin Demars and Mohamed Hassan Tawfik

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Farmer interviewed المزارع		**Questionnaire no.** رقم الأستبيان	
Surname لقب		**Date** التاريخ	
Family Name اسم العائلة		**Start time** وقت البدء	
Village القرية		**End time** وقت الانتهاء	
Latitude خط العرض		**Duration** المدة	
Longitude خط الطول		**Photo filenames**	

<table>
<tr><th></th><th></th><th></th></tr>
<tr><td>1</td><td>What are you cultivating? ماذا تزرع</td><td></td></tr>
<tr><td>2</td><td>How much land do you have (own/rent?) ما مساحة الارض التى تملكها</td><td></td></tr>
<tr><td>3</td><td>Where are the locations of land pieces that you own? اين تقع قطع الارض التى تملكها</td><td></td></tr>
<tr><td>4</td><td>How far is your land from the village/your house? كم تبعد عن منزلك او القرية</td><td></td></tr>
<tr><td>5</td><td>How many hours a day do you spend on average on the field? كم من الوقت تقضية فى الحقل كل يوم</td><td></td></tr>
<tr><td>6</td><td>What do you use to fertilise your land? ماذا تستخدم لتسميد الارض
<table>
<tr><th>Type of fertilizer</th><th>Amount(#*kg)</th><th>Cost (EGP/unit)</th><th>Annual cost(EGP)</th><th>Types of crops</th></tr>
<tr><td>Nitrate</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Urea</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Potassium</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Phosphate</td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td></td></tr>
<tr><td>7</td><td>When do you apply them? متى تضعها فى الارض</td><td></td></tr>
<tr><td>8</td><td>How much do you spend annually on fertilizers? كم تصرف من المال على المخصبات سنويا</td><td></td></tr>
<tr><td>9*</td><td>Do you apply manure on your land? هل تضع روث الحيوانات فى الارض؟</td><td></td></tr>
</table>

10*	How are you getting the manure? كيف تحصل علية	
	From own animals only من حيواناتك	
	From own animals and neighbours من حيواناتك و حيوانات الجيرا	
	Fraction of collectively stored manure in the village جزء من الروث المجمع فى القرية	
	Buy it (specify quantity and price) يقوم بشرائها (الكمية؟والثمن؟)	
11	Is the amount of manure you have enough for your whole land? هل كمية الروث كافية لتسميد الارض	
12	How do you transfer the manure to your land? كيف تنقلة الى الارض	
13	Is the manure stored before application to the land or used directly from the stable? هل يتم تخزين الروث قبل استخدامة فى الارض ام يستخدم مباشرة ؟	
14	At what time(s) of the year do you apply manure? فى أى وقت من السنة تقوم بوضع الروث على الارض	
15	Do you store the manure for a while before applying it or use it directly? What is the main practice? اذا كان يعتمد على الموسم : متى يخزن الروث ومتى يستخدم مباشرة؟ وما هو الاجراء المتبع غالبا ؟	
16	For how long is the manure stored? ما هى مدة التخزين	
17	Do you add solid waste/ straw to the heaps of the manure? Why? هل تضيف الية التبن او نفايات صلبة ؟ لماذا؟	
18	Do you stir the heaps from time to time? How often? هل تقوم بتحريكة من فترة لفترة ؟ كل كم من الوقت؟	
19	What happens to the liquid part of the manure? ماذا يحدث للجزء السائل من الروث	
20	If it is not used on fields: why not? اذا لا يتم استخدامها فى الحقول , لماذا؟	
21	If it is collected separately: in which container? Where is it discharged? How is it transported? فى حالة تجميها بشكل منفصل, ما الوعاء المستخدم؟اين يتم التخلص منها؟كيف يتم نقلها	
22	Do you use sludge from the bayaras on your fields? هل تستخدم الحمأة من البيارات فى الحقل	
23	Do you use dried sludge from wastewater treatment plants? هل تستخدم الحمأة الجافة من محطات المعالجة؟	
	For fresh and/or dried sludge: *الحمأة الجافة / غير الجافة*	
24	Do you use it regularly or seasonally? (If seasonally: details) هل تستخدمها بشكل منتظم ام على حسب الموسم (أذا كان على حسب الموسم ما هى التفاصيل)؟	
25	How much sludge do you use? (How many trucks a month for example?) ما كمية الحمأة المستخدمة ؟ (حوالى كم عربة فى الشهر؟)	
26	What effect do you see on the yield of your crops? ما هو التأثير الذى تلاحظة على المحاصيل	
27	Would you be willing to use treated wastewater to irrigate your fields? هل عندك أستعداد لأستخدام مياة الصرف المعالج فى رىً أرضك؟	
28	Do you have experience with use of wastewater? What is the impact on the yield? هل لديك خبرة سابقة فى تجربة مياة الصرف ؟ وما هو تأثيرها على المحصول؟	

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Interview Guide for Persons Responsible of Non-Residential Buildings

أستبيان خاص للأشخاص المسؤلين عن المبانى الغير سكنية

Team members: Philippe Reymond, Colin Demars and Mohamed Hassan Tawfik

Contact: Philippe Reymond, ESRISS project coordinator, 0106 483 43 14 - philippe.reymond@eawag.ch

Person interviewed الشخص الذى تمت المقابلة معة		**Questionnaire no.** رقم اللأستبيان	
Surname لقب		**Date** التاريخ	
Family Name اسم العائلة		**Start time** وقت البدء	
Position (job) الوظيفة		**End time** وقت الانتهاء	
Village القرية		**Duration** المدة	
Type of building نوع المبنى		**Photo filenames**	
Latitude خط العرض			
Longitude خط الطول			

1	Is it a governmental building هل هو مبنى حكومى؟	
2	No of users (students / staff…) عدد المستخدمين (العاملين أو الطلبة)	
3*	Do you have bayaras or sewer to collect wastewater?	
	If only sewer go to question 12 فى حالة التوصيل الى بيارة	
4*	Number of bayaras عدد البيارات	
5*	Dimensions أبعاد البيارة	
6*	Frequency of emptying عدد مرات أفراغ البيارة	
7*	No of trucks per emptying عدد المقطورات المستخدمة فى الكسح	
8*	Is the bayara emptied completely each time? هل يتم أفراغها بالكامل كل مرة	
9	Price paid **per trip** سعر النقلة	

10*	Average amount paid in water bill ? Do you keep records? متوسط فاتورة المياة المدفوعة؟ هل يوجد دفاتر لذلك؟	
11*	Where does the sludge from the bayara end up to? اين يتم التخلص من الحمأة(الوحل-الرواسب) بعد افراغ البيارة	
	Drain فى المصرف	
	Reused in fields يعاد استخدامها فى الحقل	
	Other? طرق اخرى	
	If answer to question 3 is sewer	
12	For how long have you had sewer connection? منذ متى لديك وصلة مجارى؟	
13	What type of sewers are they? (deep/shallow, diameter, material, real sewers or perforated drains to lower groundwater table?) ما هو نوع الصرف المستخدم ؟	
14*	Do they flow through a manhole first? ما هو نوع الصرف المستخدم ؟	
15	Do you face any problems with the network? هل تواجة اى مشكلات مع شبكة الصرف	
16	*If yes*: What kind of problems? (open ended) ما نوع هذة المشكلات When do most problems occur? How often? متى تحدث هذة المشكلات	
	Reading in the water meter قرأة العداد	

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On-Site Sample Analyses with Portable Lab

Working procedure

Introduction:

This working procedure has been written in order to evaluate the 7 parameters: total nitrogen (TN), ammonia (NH4), nitrate (NO3), nitrite (NO2), total phosphate (TP), ortho-phosphate (PO4), COD. It had been used to evaluate 3 type of wastewater in Egypt: septage, sewage, animal liquid manure.

This report gathers the different working procedure for the analysis of these parameters. In the procedure the "*step + number*" refer to the procedure on test box.

General remarks:

- Maximum for 6 samples and only 4 for LCK138 test
- Some parameters have to be evaluated on site: NH4, NO3 , PO4
- TP, TN, NO3 and COD can be evaluated later, ideally the same day. Samples have to be cooled down to 4°C and left to warm up at room temperature before analysis
- Nitrate and nitrite can't be evaluated for manure. The samples are too turbid and the concentration is too low to allow dilution while staying in the range.

Dissolved Oxygen, pH and conductivity have also been analysed. But, because of the easiness of the used we didn't wrote the procedure.

Devices used:

- Photometer: DR2800 from HACH-LANGE
- Thermostat: LC200 from HACH-LANGE
- Homogenizer

Test used (all from HACH-LANGE):

- LCKtest: NH4(LCK304), TN(LCK138), TP(LCK349) and COD(LCK504)
- Powder pillows: NO2(NitriVer3, method 8507), NO3(NitraVer5, method 8171) and PO4(PosphVer3, method 8048)

Material needed:

4x400ml Becker:	for the sample
2x250ml Becker:	used as bin
4x100ml Becker:	for the First filtration using 0.7µm or 0.8µm filter paper.
4x50ml Becker:	for the second filtration using 0.45µm filter paper.
12x50ml graduated cylinder:	for dilutions
4x25ml graduated cylinder:	for dilutions
6 test tubes:	for powder pillow test
2 cuvettes:	for powder pillow test

- Other: Pipette 1 and 5ml, pipette tips, pens, alcohol, gloves, disinfectant, filter holder and filter paper (at least 0.45µm), distilled water
- Cool/ice box to preserve the samples at 4 degrees.

Basics remarks:

- Always note the number of the sample, the filtration, and the dilution on the vial, Becker etc.
- When taking the solution for a non-filtrated, always mix the sample.

<table>
<tr><th colspan="4">PREPARATION</th></tr>
<tr><th></th><th>Time</th><th>Activity</th><th>Material</th></tr>
<tr><td>Preparation</td><td>0 - 40min</td><td>

Install the homogenizer and the DR.
Install and heat the thermostat to 148 degrees in the right side and 100 degrees in the left side (just for second evaluation)
Put each sample in a 400ml becker
Homogenize all samples during 1min
Make the Quicktest of NH4, PO4, NO3 and NO2
Compute the dilution and the volume needed.

LCK: 5ml needed
Powder pillow: 20ml needed

EXPECTED DILUTION
<table>
<tr><th></th><th>NH4</th><th>PO4</th><th>NO3</th><th>TP</th><th>TN</th><th>COD</th><th>NO2</th></tr>
<tr><td>Sewage</td><td>100</td><td>50</td><td>1</td><td>10</td><td>50</td><td>1</td><td>1</td></tr>
<tr><td>Septage</td><td>50-500</td><td>50</td><td>1</td><td>20 -100</td><td>100</td><td>2-10</td><td>1</td></tr>
<tr><td>Manure</td><td>2500</td><td>50</td><td>lab</td><td>50</td><td>500</td><td>10-20</td><td>lab</td></tr>
</table>

Filtrate the sample by 0.45um. <i>Filtration is needed for NH4, PO4, NO3 and NO2. For manure and septage it is recommended to pre-filter with 0.7µm or 0.8µm micron filter paper.</i>
Make the appropriate dilution for filtrated and non-filtrated solution

</td><td>2*250ml Becker
x 400ml Becker
x 50ml Becker
(x 100ml Becker)

50ml graduated cylinder
25ml graduated cylinder</td></tr>
</table>

ON-SITE EVALUATION			
	Time	**Activity**	**Material**
NH4	0min	Put the LCK304 on the support 1) LCK304: Step 1-5, *step2:keep the stopper on the same side* *step3-4: be quick* 2) Alarm 1: 15min	x LCK304 vial
	20min	Alarm 1 ring: Measure LCK304	
PO4	15min	Phosphorus: 1) Step 1-8 (need to wait 2min) 2) Rinse the two cells 3) Repeat for each sample	2 sample cells x PhosVer3
NO3	30min	Nitrate: 1) Step 1-10 (need to wait 5min) 2) Rinse the two cells 3) Repeat for each sample	2 sample cells x NitraVer5

SECOND EVALUATION

	Time	**Activity**	**Material**
COD	0min	Put the LCK514 vials on the support. 1) LCK 514: step 1-3, then 2h at 148°C on the left side of thermostat	x LCK514 vial
TP, TN	15min	Put the LCK349 vials and x dry test tubes on the support. 2) LCK349: step 1-4 3) LCK138: step1 *step 1:* ***close immediately, do not invert****.* 4) LCK349 &LCK138 during 1h at 100°C on the right side of thermostat ***Be quick***	x LCK349 vial x LCK138 dry test tube LCK138 prod. A and B
NO2	40min	Nitrite: 1) Step 1-8 (need to wait 20min) 2) Rinse the two cells 3) Set alarm Note: if more than 1 sample to analyze, do the first sample in the 2 cells, and during the break time begin another sample every 5 min in test tube. Transfer the solution from the test tube to the cells to evaluate.	2 sample cells x NitriVer3 x 10ml test tube (with stopper)
	1h30	Stop the right side of thermostat 1) Take out the vials (LCK138, LCK349) 2) Wait until they are cold.	
TN	1h50	1) LCK138: step 3-8 *step4:* ***mix until no streaks can be seen*** *step5-6:* ***pipette slowly, stopper quickly*** *step 7:* ***mix until no streaks can be seen*** 2) Alarm 1: 15 minutes	x LCK138 LCK138 prod. C and D LCK349 prod. B and C
TP	2h00	1) LCK349: mix it and then step 6-8, *step 6,7 :****close with C stopper quickly*** 2) Alarm 2: 10 minutes	
	2h10	Alarm 1 ring: LCK138, clean the outside and evaluate Alarm 2 ring: LCK349, invert a few time, clean the outside and evaluate	
COD	2h10	Stop the left side of thermostat 1) LCK 514: Mix the vials 2) LCK 514: Wait until it's cold 3) LCK 514: Clean the outside and evaluate	
		Clean and rinse all the lab material	

APPENDIX 14: Detailed household surveys results

Main observations

	House and Household population										Main Occupation					Toilets			
	Nb. of HH per buildings		People/ building		Men	Women	Child		People/ House-hold		Farmer	Wor ker	Civil servant	Shop		Per/ toilet	House with Sitting Toilets	House with Squat. Toilets	
	Nb.	nb.	Nb.	nb	%	%	%	nb		nb	%	%	%	%	nb	Nb	%	%	nb
Ashara	1.1	*9*	7	*18*	29%	24%	47%	*11*	5.75	*8*	50%	14%	29%	7%	*12*	4.8	11%	100%	*18*
Kabeel			10.7	*22*	32%	31%	37%	*10*	3.6	*8*	38%	19%	44%	0%	*13*	5.2	23%	100%	*22*
Hamamee			9.8	*18*	30%	28%	42%	*16*		-	16%	16%	68%	0%	*18*	4.3	33%	94%	*18*
Haderi	3.15	*20*	14.0	*18*	-	-	-		4.9	*12*	80%	0%	20%	0%	*20*	4.8	75%	90%	*20*
M. Nassar	2.43	*23*	10.8	*23*	34%	29%	36%	*22*	4.7	*12*	39%	57%	4%	0%	*23*	4.4	52%	87%	*23*
K. an Nuss	3	*23*	11.9	*23*	36%	28%	36%	*10*	4.3	*23*	54%	15%	17%	13%	*23*	4.2	57%	83%	*23*
Fishah	2.5	*23*	11.4	*23*	28%	33%	39%	*23*			48%	35%	17%	0%	*23*				
K. a. Khalifa	3	*23*	13.6	*23*	31%	28%	41%	*23*			83%	17%	0%	0%	*23*				
Average	**2.53**		**11.1**		**32%**	**29%**	**40%**		**4.7**							**4.6**	**42%**	**92%**	
Min			7.0		28%	24%	36%		3.6							4.2	11%	83%	
Max			14.0		36%	33%	47%		5.8							5.2	75%	100%	
σ			2.2		3%	3%	4%		0.8							0.4	24%	7%	

Water supply

	General												Quality water supply					
	Nb. of taps		Freq. Check water meters		Wat. Cons			HH with Other sources		Price			HH with Pump	Low pressure	Taste	Interruption		
		nb	[day]	nb	l/cap	σ	nb	%	nb	L.E./ cap.month	range	nb	%	% compl.	% compl.	% compl.	freq. [day]	nb
Ashara	2.5	*12*	30	*11*	-	-	-	25%	*12*	1.2	*0.8-1.2*	*16*	67%	67%	17%	66%	2.2	*12*
Kabeel	4.8	*13*	30-irr.	*12*	-	-	-	54%	*13*	2.0	*1.1-8*	*17*	58%	67%	38%	92%	11.1	*11*
Hamamee	4.6	*18*	irregular	*14*	-	-	-	72%	*18*	1.4	*0.8-5*	*14*	14%	50%	42%	79%	14.3	*14*
Haderi	9.7	*18*	30-90	*19*	59.1	*20.4*	*11*	40%	*10*	2.6	*0.9-14*	*18*	100%	100%	47%	88%	2.0	*19*
M. Nassar	4.9	*22*	30-60	*22*	110.3	*32.6*	*16*	-	-	4.9	*0.8-18*	*18*	5%	42%	32%	70%	4.1	*20*
K. an Nuss	5.9	*20*	30-120	*21*	86.3	*36.3*	*9*	64%	*11*	2.2	*1-11*	*19*	100%	100%	77%	92%	1.2	*22*
Fishah					104.0	*median*	*21*						22%	61%		71%	2.6	*15*
K. a. Khalifa					74.0	*median*	*12*						100%	78%		52%	0.8	*21*
Average	**5.4**							**51%**		**2.4**								
Min	2.5							25%		1.2								
Max	9.7							72%		4.9								
σ	2.4							27%		1.3								

Greywater and sanitation system

	GREYWATER								
	Greywater				Greywater discharge place				
	HH with washing machine		Dish-wash. in sink		Bayara	Street	Sewer	Canal/ drain	
	%	nb	%	nb	%	%	%	%	nb
Ashara	89%	*18*	67%	*4*	44%	36%	0%	19%	18
Kabeel	91%	*22*	72%	*8*	11%	8%	80%	1%	22
Hamamee	89%	*18*	-	-	0%	6%	75%	19%	18
Haderi	94%	*19*	66%	*19*	57%	21%	0%	22%	19
M. Nassar	100%	*23*	87%	*23*	0%	2%	89%	7%	23
K. an Nuss	87%	*23*	74%	*23*	2%	12%	80%	6%	21
Fishah					0%	5%	90%	5%	23
K. a. Khalifa					5%	7%	86%	2%	23
Average	**92%**		**73%**						
Min	87%		66%						
Max	100%		87%						
σ	5%		31%						

	SANITATION SYSTEM		
	Type sanitation sys.		
	Bayaras	Sewer	
	%	%	nb
Ashara	100%	0%	12
Kabeel	20%	80%	-
Hamamee	0%	100%	18
Haderi	100%	0%	20
M. Nassar	0%	100%	23
K. an Nuss	5%	95%	21
Fishah	5%	95%	23
K. a. Khalifa	10%	90%	23

Sewer network

	SEWER NETWORK							
	Price sewer							
	HH connection			Main sewer			Maintenance	
	L.E/HH	range	nb	L.E/HH	range	nb	LE/HH.month	nb
Ashara	-	-	-	-	-	-	-	-
Kabeel	330	100-700	7	130.0	0-700	2	5.0	3
Hamamee	450	100-1000	12	215.0	100-600	15	-	-
Haderi	-	-	-	-	-	-	-	-
M. Nassar	410	300-1000	11	610.0	200-1200	8	0-50	13
K. an Nuss	1010	600-1500	9	1170.0	1000-1500	7	3.3	7
Fishah	352	100-1000	12	520.0	200-1200	11	41LE/H.month	4
K. a. Khalifa	970	500-2000	13	1000.0	500-3000	14	23.1/H.month	12
Average	**587**			**608**				
Min	330			130				
Max	1010			1170				
σ	381			449				

Bayaras

	Bayaras							Emptying bayaras						Bayaras Problem								
	Wall with cement	Bottom with soil	Drain. layer		Volume	Depth		Freq empty	nb Trips	Complete emptying?	trip price			Over-flow	Affect building	Emptying freq	Other	Occurance			Greywat. In canal/str	
																		Sum.	Win.			
	%	%	%	nb	m3	m	nb	[days]	nb	%	L.E/trip	range	nb	%	%	%	%	%	%	nb	%	nb
Ashara	75%	8%	0%	12	14	2.5	12	23	2.3	78%	22	15-40	9	16%	8%	0%	8%	-	-	12	67%	12
Kabeel	80%	20%	0%	5	8	2.0	5	27	5.0	100%	43	30-50	3	0%	20%	0%	0%	-	-	5	60%	5
Hamamee	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Haderi	30%	80%	50%	20	23	2.3	20	10	3.5	58%	50	30-90	19	80%	15%	15%	-	55%	15%	20	55%	20
M. Nassar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K. an Nuss	33%	100%	100%	3	12	2.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fishah																						
K. a. Khalifa																						

Animals

	Cattle					Liquid manure discharge						Stable	DW for cows				
	HH with cow	Nb. cow		Liq. Manure produce		Bayaras	Sew.	Field	D./Canal	Street		Clean with DW	Public Tap	HH	Canal	Field	
	%	cow/cap	nb	l/cow	nb	%	%	%	%	%	nb	%	%	%	%	%	nb
Ashara	64%	0.28	18	-	-	20%	0%	40%	40%	0%	18	-	-	-	-	-	-
Kabeel	38%	0.06	22	-	-	0%	13%	67%	7%	13%	22	-	-	-	-	-	-
Hamamee	17%	0.04	18	-	-	0%	33%	50%	0%	17%	18	-	-	-	-	-	-
Haderi	80%	0.51	19	11.4	17	25%	0%	0%	63%	13%	17	25%	7%	61%	25%	7%	17
M. Nassar	52%	0.14	23	16.4	11	0%	42%	33%	25%	0%	11	17%	-	27%	-	73%	11
K. an Nuss	52%	0.11	21	20.9	13	0%	9%	18%	73%	0%	13	23%	-	100%	-	-	13
Fishah	96%	0.27	23			0%	52%	34%	14%	0%							
K. a. Khalifa	91%	0.29	23			0%	65%	27%	7%	0%	20						
Average	**61%**	**0.21**		**16**		**6%**	**27%**	**34%**	**29%**	**5%**							
Min	17%	0.04		11		0%	0%	0%	0%	0%							
Max	96%	0.51		21		25%	65%	67%	73%	17%							
σ	27%	0.15		9		11%	25%	20%	27%	7%							

APPENDIX 15: Tariff system for water bills in Governorate of Beheira

(in 2013)

Type of building	**EGP per cubic meter**
Residential	
1:10 cbm	0.23
1:20 cbm	0.35
1:40 cbm	0.45
40< cbm	0.50
Commercial	
Super market – barber – accountability office- office of attorney –clinic……etc	1.00
Slaughter – café – 3 stars hotel – shops for dairy goods	1.50
Large factories	2.40
Governmental	1.00
Investment	
Banks-public sector companies	2.40
Domestic sewage	50%
Sewage (for the rest)	75%

APPENDIX 16: Detailed results sampling campaign sewage

SAMPLES TAKEN BY THE ESRISS PROJECT IN FIVE EZBAS IN BEHEIRA GOVERNORATE: Hamamee (Abo Hommos), Minshet Nassar (Zawyet Ghazal, Damanhur), Kawm abo Khalifa (Gawad Hosny, Damanhur), Fisha el Safra (Fisha, Damanhur), Kawm an Nuss (Bulin, Kafr el Dawar)

Sampling methodology:

Raw wastewater was collected directly from the outlet of an sewer network or from a manhole as close as possible to the latter. In order to eliminate the effect of individual events composite sample were produced. Two type of composite samples were produced: i) composite samples over 5 hours composed of 50 mL subsamples taken every 15 min between 8 am and 1 pm; ii) composite samples over 90 minutes composed of six subsamples of 220 mL taken every 15 min; this method was used to assess the variation within the morning sampling and the two full-day sampling.

SEWAGE **Minshet Nassar**		**Pipe A** 04.04.2013	**Pipe B** 04.04.2013	**Pipe C** 23.04.2013					
PARAMETERS	**Unit**	08:15-13:00	08:15-13:00	08:15-13:00	**AVG**	*SD*	MAX	**NB. OF SAMPLE**	
pH	-	7.7	7.9	7.4	**7.7**	*0.2*	7.9	3	**pH**
Cond.	mS/cm			1.3	**1.3**			1	**Cond.**
BOD	mg/L	492	543	610	**548**	*48*	610	3	**BOD**
COD	mg/L	679	778	907	**788**	*94*	907	3	**COD**
TS	mg/L	1112	1202	1350	**1221**	*98*	1350	3	**TS**
TSS	mg/L	152	140	225	**172**	*38*	225	3	**TSS**
NO2-N	mg/L	<0.022	<0.006	0.037	**0.037**			1	**NO2-N**
NO3-N	mg/L	<0.4	<0.4	0.4	**0.4**			1	**NO3-N**
NH4-N	mg/L	<47.8	<49.2	42	**42**			1	**NH4-N**
TN	mg/L	114	<95.5	105	**110**	*4*	114	2	**TN**
PO4-P	mg/L	<9.0	<5.4	5.7	**5.7**			1	**PO4-P**
TP	mg/L	8.5	5.9	6.2	**6.9**	*1.2*	8.5	3	**TP**

SEWAGE	Morning samples													
Kawm Abo Khalifa		**Sewer outlet** 31.03.2014				**Sewer outlet** 01.04.2014				**Sewer outlet** 02.04.2014				**K. a. Khalifa** Total average 03-04.2014
PARAMETERS	**Unit**	08:15-09:30	09:45-11:00	11:15-12:30	AVG	08:15-09:30	09:45-11:00	11:15-12:30	AVG	08:15-09:30	09:45-11:00	11:15-12:30	AVG	
pH	-	8.6	8.2	8.0	**8.3**	8.5	8.3	8.1	**8.3**	8.5	8.2	8.1	**8.3**	**8.3**
DO	mg/L	0.5	0.5	0.8	**0.6**	0.3	0.5	0.6	**0.5**	0.4	0.7	0.3	**0.5**	**0.52**
Cond.	mS/cm	4.1	3.2	3.0	**3.4**	3.7	3.0	2.8	**3.1**	3.7	3.2	2.8	**3.2**	**3.3**
Temp	°C	20.4	22.2	24.7	**22.5**	21.0	24.8	24.7	**23.5**	25.4	26.0	26.4	**26.0**	**24.0**
BOD	mg/L	1320	1056	957	**1111**	990	759	693	**814**	957	825	690	**824**	**916**
COD	mg/L	1950	1504	1381	**1612**	1594	1403	1147	**1381**	1774	1456	1282	**1504**	**1499**
TS	mg/L	3288	2596	2714	**2866**	3315	2555	2525	**2798**	3275	2715	2254	**2748**	**2804**
TSS	mg/L	546	492	312	**450**	353	224	283	**287**	359	502	349	**403**	**380**
TDS	mg/L	2610	2080	1720	**2137**	2960	2330	2230	**2507**	2280	2210	1910	**2133**	**2259**
NO2-N	mg/L	0.12	0.37	0.49	**0.33**	0.20	0.18	0.30	**0.23**	0.76	1.18	0.56	**0.83**	**0.462**
NO3-N	mg/L	1.0	1.6	1.1	**1.2**									**1.2**
NH4-N	mg/L	275	140	114	**176**	202	152		**177**	196	172	137	**168**	**174**
TN	mg/L	323	206	173	**234**	305	187	142	**211**	272	211	146	**209**	**218**
PO4-P	mg/L		14.2	9.8	**12.0**	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**	**4.0**
TP	mg/L	16.7	14.6	13.4	**14.9**	15.1	13.9	12.4	**13.8**	14.7	13.6	12.6	**13.6**	**14.1**

SEWAGE Full day samples

Fisha el Safra

Fisha el Safra - Pipe A
06.05.2014

PARAMETERS	Unit	03:45-05:00	05:15-06:30	06:45-08:00	08:15-09:30	09:45-11:00	11:15-12:30	12:45-14:00	14:15-15:30	15:45-17:00	17:15-18:30	AVG	MAX	NB. OF SAMPLE
Flow	L/min	10.7	21.7	33.7	24.1	18.3	16.3	19.2	19.4	17.2	20.0	20.8	33.7	10
pH	-	8.2	8.5	8.5	8.4	8.3	8.3	7.9	8.5	8.0	8.1	8.3	8.5	10
DO	mg/L	1.6	1.9	1.3	1.4	1.4	2.0	2.4	0.4	0.7	0.9	1.34	2.39	10
Cond.	mS/cm	3.2	3.2	3.0	3.2	2.8	2.1	1.6	3.8	2.7	2.2	2.9	3.77	10
Temp	°C	23.1	22.8	23.9	23.9	23.8	24.3	24.2	24.3	23.7	23.5	23.7	24.33	10
BOD	mg/L	495	561	396	561	363	495	330	825	528	429	507	825	10
COD	mg/L	1022	1112	1588	1418	1186	1220	816	1824	1382	968	1294	1824	10
TS	mg/L	1308	1655	2160	1797	1294	1354	954	2262	1480	1240	1620	2262	10
TSS	mg/L	270	416	272	236	264	288	180	536	380	256	320	536	10
TDS	mg/L	755	821	951	872	683	689	603	981	781	699	805	981	10
NO2-N	mg/L	0.084	0.001	0.000	0.000	0.128	0.048	0.041	0.066	0.051	0.119	0.049	0.13	10
NO3-N	mg/L	1.5	2.3	1.6	0.7	3.1	4.1	2.4	3.4	2.8	2.1	2.3	4.10	10
NH4-N	mg/L	177	162	217	205	133	155	115	213	160	105	170	217	10
TN	mg/L	205	327	301	241	155	164	129	264	243	199	234	327	10
PO4-P	mg/L		7.8	9.3	7.7	9.0				9.3	6.7	5.0	9.3	6
TP	mg/L	10.9	12.9	15.4	10.5	10.0	7.3	7.4	12.1	11.7	8.6	10.7	15.4	10

SEWAGE		Morning samples												
Fisha el Safra		**Pipe A** 07.04.2014				**Pipe A** 08.04.2014				**Pipe A** 09.04.2014				**Fisha el Safra** Pipe A Total average 04.2014
PARAMETERS	**Unit**	08:15-09:30	09:45-11:00	11:15-12:30	AVG	08:15-09:30	09:45-11:00	11:15-12:30	AVG	08:15-09:30	09:45-11:00	11:15-12:30	AVG	
Flow	L/min									10.4	13.8	19.6	**14.6**	
pH	-	8.0	8.2	8.5	**8.2**	8.2	7.9	8.6	**8.2**	8.4	8.2	8.5	**8.3**	8.3
DO	mg/L	3.0	2.0	1.8	**2.3**	1.4	3.3	2.1	**2.3**	3.6	4.7	3.6	**4.0**	2.85
Cond.	mS/cm	2.0	2.7	4.1	**2.9**	2.5	1.8	7.0	**3.7**	2.3	1.6	2.4	**2.1**	2.9
Temp	°C	20.3	27.4	28.7	**25.5**	22.9	28.5	23.8	**25.1**	23.1	23.2	25.1	**23.8**	24.8
BOD	mg/L	495	528	637	**553**	627	891	1551	**1023**	680	330	759	**590**	722
COD	mg/L	1134	834	1278	**1082**	1272	1920	2810	**2001**	1306	736	1664	**1235**	1439
TS	mg/L	1890	1760	2455	**2035**	2235	2380	5590	**3402**	1970	1465	2085	**1840**	2426
TSS	mg/L	298	196	262	**252**	306	496	612	**471**	228	166	372	**255**	326
TDS	mg/L	1381	1510	1870	**1587**	1433	1266	2970	**1890**	1353	1043	1357	**1251**	1576
NO2-N	mg/L	0.12	0.07	0.13	**0.11**	0.07	0.08	0.09	**0.08**	0.04	0.12	0.15	**0.10**	0.096
NO3-N	mg/L	3.1	2.8	4.8	**3.6**	7.7	8.4	3.3	**6.5**	3.7	2.7	11.3	**5.9**	5.3
NH4-N	mg/L	130	114	180	**141**	137	113	235	**161**	110		75	**92**	132
TN	mg/L	142	151	234	**176**	159	115	450	**241**	125	66	108	**99**	172
PO4-P	mg/L			4.4	**4.4**	9.1	10.3		**9.7**	3.9	4.2	9.9	**6.0**	6.7
TP	mg/L	8.2	8.4	7.7	**8.1**	11.8	11.7	10.7	**11.4**	7.3	5.2	11.7	**8.1**	9.2

SEWAGE		morning samples				
Fisha el Safra		**Pipe B** 07.04.2014	**Pipe B** 09.04.2014	**Fisha el Safra** Pipe B 04.2014	**Pipe C** 08.04.2014	**Fisha el Safra** Pipe C 04.2014
PARAMETERS	**Unit**	08:15-12:30	08:15-12:30		08:15-12:30	
Flow	L/min					
pH	-	8.2	8.1	**8.1**	8.0	**8.0**
DO	mg/L	2.4	2.7	**2.55**	2.63	**2.63**
Cond.	mS/cm	3.2	2.5	**2.8**	2.0	**2.0**
Temp	°C	24.3	23.7	**24.0**	26.0	**26.0**
BOD	mg/L	759	561	**660**	340	**340**
COD	mg/L	1556	1226	**1391**	896	**896**
TS	mg/L	2920	1990	**2455**	1525	**1525**
TSS	mg/L	420	293	**357**	288	**288**
TDS	mg/L	2090	1398	**1744**	1075	**1075**
NO2-N	mg/L	0.07	0.07	**0.070**	0.095	**0.095**
NO3-N	mg/L	1.9	7.1	**4.5**	3.9	**3.9**
NH4-N	mg/L	199	137	**168**	84	**84**
TN	mg/L	241	152	**196**	122	**122**
PO4-P	mg/L	5.9	5.5	**5.7**	5.5	**5.5**
TP	mg/L	13.0	9.2	**11.1**	7.7	**7.7**

SEWAGE																				
Kawm An Nuss		14.05.2013					15.05.2013						17-18.06.2013							
PARAMETERS	**Unit**	06:15-7:30	07:45-9:00	09:15-10:30	10:45-12:00	12:00-13-30	13:45-15:00	15:15-16:30	16:45-18:00	18:15-19:30	19:45-21:00	21:15-22:30	22:45-24:00	00:15-01:30	01:45-03:00	03:15-04:30	04:45-06:00	**AVG**	MAX	NB. OF SAMPLE
Flow	L/min	43.3	52.1	89.9	106.7	128.3	79.7	64.7	60.3	65.3	85.1	100.1	105.6	100.9	76.4	48.5	46.7	**78.4**	128.3	16
pH	-	7.3	7.1	7.1	7.4	7.5	7.3	7.3	7.2	7.1	7.1	7.0	7.1	7.1	7.0	7.0	7.0	**7.2**	7.5	16
DO	mg/L	0.4	0.7	0.6	0.1	0.1	0.4	0.5	0.6	0.8	0.8	0.8	0.8	0.4	0.6	0.9	0.6	**0.54**	0.86	16
Cond.	mS/cm	2.1	1.9	1.9	2.7	3.3	2.9	3.0	2.8	2.5	2.3	2.4	1.9	1.9	1.8	1.8	1.7	**2.4**	3.30	16
Temp	°C																			
BOD	mg/L	360	240	250	400	620	550	600	390	500	510	400	280	250	260	225	200	**391**	620	16
COD	mg/L	489	414	397	659	896	843	948	782	688	640	669	457	440	436	428	380	**614**	948	16
TS	mg/L	590	820	972	1062	2100	1540	2100	1600	1620	990	1060	1133	1110	1223	990	960	**1282**	2100	16
TSS	mg/L												47	47	57	60	53			
TDS	mg/L																			
NO2-N[1]	mg/L																			
NO3-N[1]	mg/L	1.5	2.2	1.8	2.3	2.0	2.4	2.7	2.9	2.1	2.6	3.1	0.6		0.6	0.9	0.4	**1.8**	3.08	15
NH4-N[1]	mg/L	85.2	68.5	70.0	124.0	169.0	140.0	122.0	120.0	73.9	94.3	94.5	77.4	69.0	64.1	63.7	66.8	**98**	169	16
TN	mg/L	103.25	87	83	158	205.75	172.5	167.5	150.25	124	116.25		76.1	89.9	74.7	79.1	70.7	**113**	206	15
PO4-P[1]	mg/L	9.8	8.1	7.0	8.7	12.0	13.3	12.3	10.6	11.1	13.5	10.4	7.3	6.6	7.3	6.5	5.7	**9.5**	13.5	16
TP	mg/L	8.41	7.16	7.01	10.6	13.6	14	13.3	12	11	10.9	10.8	7.95	8.25	7.34	6.93	5.94	**10.0**	14.0	16

[1] The concentration of nitrate, ammonium and orthophosphate do not represent what can be found in fresh sewage, they should be taken as indicative values (see Baseline data report, chapter 5.1.1: Result of sampling campaign - Daily variation)

The flow was obtain every 15min by measuring the time needed for an 18 liter bucket to fill up.

SEWAGE									
Kawm An Nuss		13.04.2014(!)				05.05.2014(!!)			
PARAMETERS	**Unit**	08:15-09:30	09:45-11:00	11:15-12:30	AVG	08:15-09:30	09:45-11:00	11:15-12:30	AVG
Flow	L/min	142.6	132.1	108.5	**127.8**	27.5	28.4	14.7	**23.5**
pH	-	7.3	7.3	7.5	**7.4**	7.3	7.3	7.4	**7.3**
DO	mg/L	0.8	0.8	0.1	**0.5**	0.1	0.0	0.0	**0.1**
Cond.	mS/cm	1.3	1.3	2.6	**1.7**	4.6	4.7	4.6	**4.6**
Temp	°C	22.5	23.6	24.7	**23.6**	25.2	25.5	27.3	**26.0**
BOD	mg/L	168	138	363	**223**	462	429	460	**450**
COD	mg/L	236	254	618	**369**	1106	1126	1092	**1108**
TS	mg/L	968	1120	1928	**1339**	2160	2177	2180	**2172**
TSS	mg/L	88	84	292	**155**	248	144	264	**219**
TDS	mg/L	946	935	1472	**1118**	1419	1499	1600	**1506**
NO2-N^{1}	mg/L	0.01	0.00	0.00	**0.01**	0.02	0.02	0.01	**0.01**
NO3-N^{1}	mg/L	1.7	1.1	4.6	**2.5**	39.0	60.0	70.0	**56.3**
NH4-N^{1}	mg/L		37	137	**87**				
TN	mg/L	44	56	141	**80**	238	264	266	**256**
PO4-P^{1}	mg/L	3.3	3.1	7.0	**4.5**	19.4	19.7		**19.6**
TP	mg/L	3.8	4.1	9.5	**5.8**	23.0	22.2	22.4	**22.5**

(!) Clogged network. According tho the sewer maintenance operator, only 20% of the network is working proprely

(!!) Low flow: the village was affected by a drinking water interruption lasting since a couple of days.

	16.04.2013 (!!)	14.04.2014(!!)	
	08:15-13:00	23:15-00:30	AVG
Flow		135.0	**135.0**
pH	7.6	7.0	**7.3**
DO	0.6	0.6	**0.6**
Cond.	2.5	3.9	**3.2**
Temp		19.0	
BOD	950	1023	**987**
COD	1140	2062	**1601**
TS		3116	**3116**
TSS	1020	720	**870**
TDS		2110	**2110**
NO2-N	<0.066	0.00	**<0.066**
NO3-N	<0.8	31.2	
NH4-N	<111.0		**<111**
TN	154	238	**196**
PO4-P	<9.1	16.8	**12.9**
TP	8.7	21.3	**15.0**

(!!!) Unclogging happened during sampling, thus values are much higher

APPENDIX 17: Detailed results sampling campaign septage

SAMPLES TAKEN BY ESRISS PROJECT IN FOUR EZBAS IN BEHEIRA GOVERNORATE: El Ashara (Besentway, Abo Hommus), Khediry (next to Ashara), El Hadery (Besentway, Abo Hommus), Nakhla Kablaia (next to El Hadery)

SEPTAGE		**Ashara**[1] 06.02.2012			**Khediry**[1] *(ezba next to Ashara)* 06.02.2012	**Hadery** 09.04.2013				**Nakhla Kablaia** *(ezba next to Haderi)* 10.04.2013				**Nakhla Kablaia** *(ezba next to Haderi)* 30.04.2013				**AVERAGE**	**SD**	**MAX**	**NB. OF SAMPLE**	
PARAMETERS	**Unit**																					
pH	-	7	7.8	7.8	7.7	7.7	8.2	8.2	7.7	8.1	8.1	7.9	7.9	7.7	7.4	7.4	7.3	**7.8**	0.3	8.2	16	**PH**
DO	mg/L									0.15	0.13	0.11	0.15	0.13		0.14	0.18	**0.14**	0.02	0.18	7	**DO**
Cond.	mS/cm									8.62	7.55	2.65	5.82	3.54	2.75	2.66	2.90	**4.56**	2.43	8.62	8	**Cond.**
BOD	mg/L					>3600	182	172	840	>3600		656	5800	1000		2300		**2017**	1864	5800	9	**BOD**
COD	mg/L	3195	2275	2250	1205	15225	375	430	1520	8313	5531	1330	12294	1321		10686		**4711**	4916	15225	14	**COD**
TS	mg/L	2972	1186	703	465	28400	1400	1108	4020	23200	3400	2100	17200	1410	1100	2190	1804	**5791**	8800	28400	16	**TS**
TSS	mg/L	2120	590	305	300	3900	138	127	740	2400	720	310	3740	708	640	1020	580	**1146**	1223	3900	16	**TSS**
TVS	mg/L	1470	400	265	210													**586**	595	1470	4	**TVS**
NO2-N	mg/L									0.13	0.02	0.03	0.08	0.00	0.01	0.00	0.00	**0.03**	0.05	0.13	8	**NO2-N**
NO3-N	mg/L									1.86	0.30	0.59	0.81	1.59	3.88	4.07	3.78	**2.11**	1.57	4.07	8	**NO3-N**
NH4-N	mg/L	157	348	392	213	57	63	104	90	735	452	163	565	238	242	233	204	**266**	190	735	16	**NH4-N**
TN	mg/L	896	700	826	406	310	107	150	168	1290	669	257	752	300	260	507	215	**488**	335	1290	16	**TN**
PO4-P	mg/L									4.9	3.9	5.3	5.2	20.9	19.6	16.9	16.5	**11.6**	7.4	20.9	8	**PO4-P**
TP	mg/L	9.0	7.6	9.9	11.1	>23.9	6.3	9.2	12.6	159.0	55.7	19.7	69.3	25.9	22.2	50.1	20.6	**32.5**	39.5	159.0	16.0	**TP**

Sampling methodology:

Sampling of septage was made directly from the vacuum trucks. 500 ml of septage was collected at the beginning of discharging of the truck, when it was half empty and shortly before the end, to make sure that the septage analysed will be as close as possible to what would actually reach a treatment unit. The samples were subsequently mixed in a 1.5 L plastic bottle and refrigerated immediately.

The incoherent values have been deleted

[1] Result need to be confirmed by other samples taken in winter

APPENDIX 18: Detailed results sampling campaign liquid animal manure

SAMPLES TAKEN BY ESRISS PROJECT IN FOUR EZBAS IN BEHEIRA GOVERNORATE: El Ashara (Besentway, Abo Hommus), Kabeel (Zawyet Ghazal, Damanhur), El Hadery (Besentway, Abo Hommos) and Minshet Nassar (Zawyet Ghazal, Damanhur)

LIQUID MANURE		**Kabeel**[1] 01.02.2012			**Ashara**[1] 02.02. 2012	**Hadery** 17.04.2013				**Minshet Nassar** 24.04.2013				**Minshet Nassar** 29.04.2013								
Parameter	**unit**																	AVER AGE	SD	MAX	NB. OF SAMPLE	
pH	-	8.7	8.6	8.8	8.6					9.1	8.8	9.0	9.1	8.8	8.8	8.8	8.6	**8.8**	0.2	9.1	12	**PH**
DO	mg/L									0.11	0.12	0.10	0.07	0.12	0.20	0.72	0.36	**0.23**	0.22	0.72	8	**DO**
Cond.	mS/cm									37.10	44.00	45.50	34.60	37.40	41.70	43.20	37.00	**40.06**	4.01	45.50	8	**Cond.**
BOD	mg/L	5150	8640	8400	7395.5	7400	7300	7200	>8000	9600	13800	11600	6700	8100	8600	12700	7900	**8699**	3136	13800	16	**BOD**
COD	mg/L	8625	15000	14225	12501	16733	15389	16213	22320	19277	17557	16500	8922	12863	13024	20405	13293	**15178**	3740	22320	16	**COD**
TS	mg/L	7480	10056	13445	9337	38600	43160	35330	39810	29400	41500	37200	28100	28500	31500	36400	26200	**28501**	12082	43160	16	**TS**
TSS	mg/L	4560	6620	8600	2070	5300	5650	7560	9640	4100	6200	5000	3800	3900	4600	11200	4000	**5800**	2411	11200	16	**TSS**
NO2-N	mg/L									0.05	0.03	0.06	0.05	0.30	0.78	0.94	0.53	**0.34**	0.36	0.94	8	**NO2-N**
NO3-N	mg/L													3.20	4.42	9.31	4.80	**5.43**	2.67	9.31	4	**NO3-N**
NH4-N	mg/L	1680	1680	2072	2380	2895		3425	3095	1635	373	1645	1148			408	293	**1748**	1027	3425	13	**NH4-N**
TN	mg/L	2386	2520	4340	3500	3910	2355	3930	3560	4385	4265	2730	2775			1085	885	**3045**	1138	4385	14	**TN**
PO4-P	mg/L									4.0	1.4		3.0	4.1	1.7	4.3	0.8	**2.8**	1.4	4.3	7	**PO4-P**
TP	mg/L	70	11.6	10.5	34.2	23.8	11.6	48.05	37	33.1	18.85	11.15	20.8	13.1	31.5	50.5	23.85	**28**	17	70	16	**TP**

Sampling methodology:

Grab samples were taken from the holes for the collection of liquid manure in the stables. The content of the holes was gently stirred and a sample of 600 ml was taken with a graded plastic jar. The samples were transferred into plastic bottles and refrigerated immediately. The sampling took place between 7:30 and 8:30 am, before the daily emptying of the collection holes.

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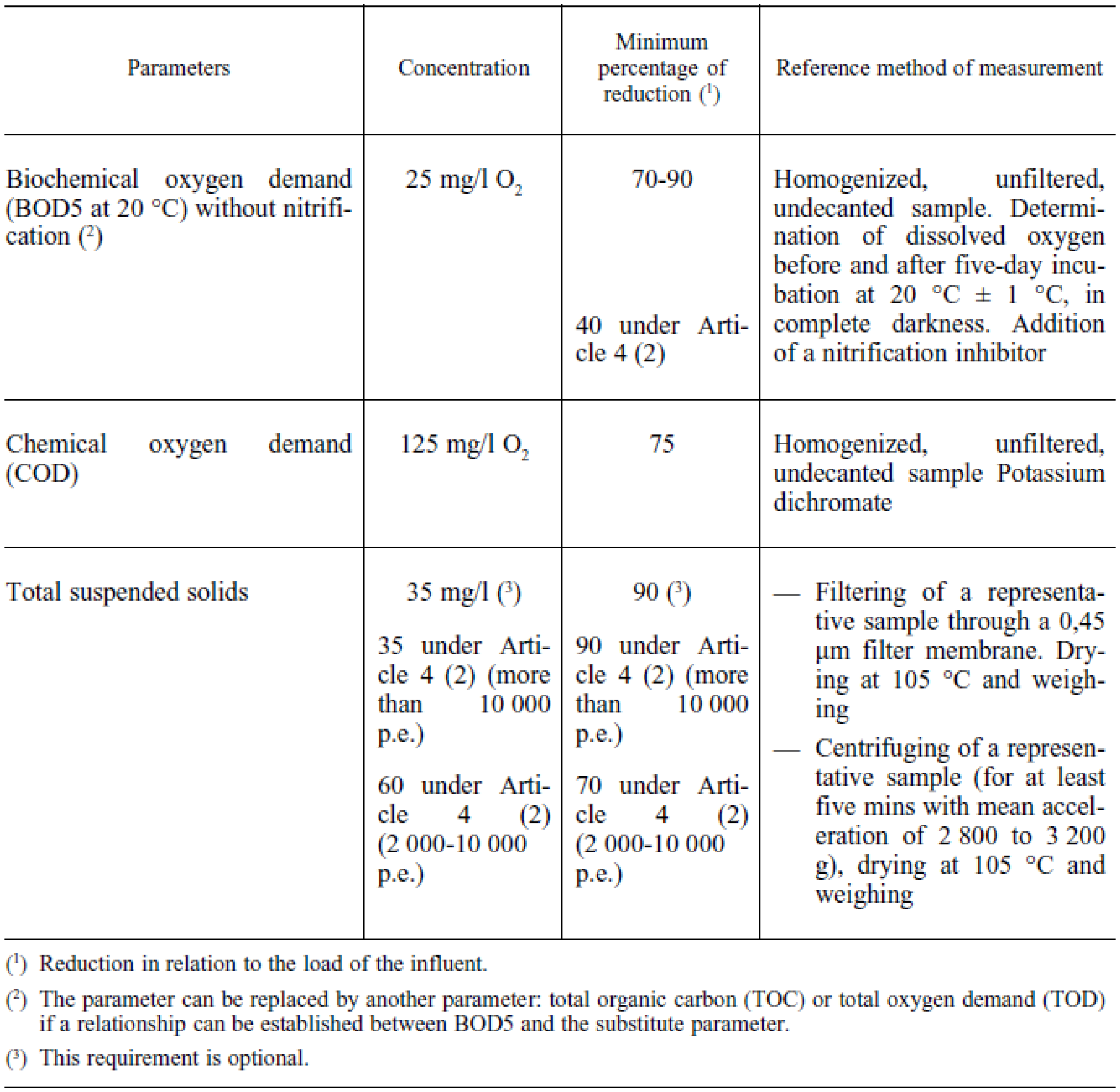
[1] Result need to be confirmed by other samples taken in winter

APPENDIX 19: EU standards

Table from the Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC).

Requirements for discharges from urban wastewater treatment plants subject to Articles 4 and 5 of the Directive. The values for concentration or for the percentage of reduction shall apply.



Parameters	Concentration	Minimum percentage of reduction (1)	Reference method of measurement
Biochemical oxygen demand (BOD5 at 20 °C) without nitrification (2)	25 mg/l O_2	70-90 40 under Article 4 (2)	Homogenized, unfiltered, undecanted sample. Determination of dissolved oxygen before and after five-day incubation at 20 °C ± 1 °C, in complete darkness. Addition of a nitrification inhibitor
Chemical oxygen demand (COD)	125 mg/l O_2	75	Homogenized, unfiltered, undecanted sample Potassium dichromate
Total suspended solids	35 mg/l (3) 35 under Article 4 (2) (more than 10 000 p.e.) 60 under Article 4 (2) (2 000-10 000 p.e.)	90 (3) 90 under Article 4 (2) (more than 10 000 p.e.) 70 under Article 4 (2) (2 000-10 000 p.e.)	— Filtering of a representative sample through a 0,45 µm filter membrane. Drying at 105 °C and weighing — Centrifuging of a representative sample (for at least five mins with mean acceleration of 2 800 to 3 200 g), drying at 105 °C and weighing

(1) Reduction in relation to the load of the influent.

(2) The parameter can be replaced by another parameter: total organic carbon (TOC) or total oxygen demand (TOD) if a relationship can be established between BOD5 and the substitute parameter.

(3) This requirement is optional.

Document accessed under:
http://eur-lex.europa.eu/LexUriServ/site/en/consleg/1991/L/01991L0271-19980327-en.pdf
(last accessed November 2013)

The ESRISS project deals with the sanitation planning gap in Nile Delta villages which cannot be connected to large centralised treatment plants. Led by the Swiss Federal Institute of Aquatic Science and Technology (Eawag-Sandec) in partnership with the Egyptian Holding Company for Water and Wastewater (HCWW) and funded by the Swiss State Secretariat for Economic Affairs (SECO), it aims to provide baseline data, policy recommendations and planning tools for the scaling-up of small-scale sanitation in Egypt.

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