All men are equal before fish[1] or how Netherlands East Indian irrigation entered the international irrigation arena after World War II

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Abstract

Shortly after WWII, three new professors were appointed at Dutch universities in fields that were closely connected to engineering in the former Netherlands East Indies, the modern Republic of Indonesia. Before WWII, the East Indies provided a steady work space for new engineering graduates, but the independence of the Republic of Indonesia after WWII had clearly changed this. However, Dutch irrigation professionals broadened the perspective of Dutch engineering from the East Indies to all tropical regions. They stated that their predecessors had thoroughly studied and defined the principles which had to be applied when designing and constructing irrigation systems in "tropical regions". In other words, "tropics" was made equal to "Javanese". In this way, the specific East Indian irrigation concept was fitted to a general approach of distributing water to smallholders. This paper will discuss this shift in analyzing how the irrigation approach developed in the Netherlands East Indies was redefined and made applicable to the tropics in general.

Introduction

Indonesia's independence in 1945 effectively put a halt to Dutch engineering efforts in the archipelago (see Ertsen 2010 for an overview of colonial irrigation in Indonesia). At the end of the 1940s and beginning of the 1950s it had become clear that the high number of Dutch irrigation engineers working in the East Indies would not be reached anymore; the East Indies as employment option had disappeared. The number of active engineers between 1945 and 1949 had already been limited in comparison with the period before World War II, when about 280 engineers were employed by the Department of Public Works. After 1945, irrigation received relatively little attention; restoring and building transportation infrastructure was of much higher importance in the uncertain situation. Furthermore, unlike transportation facilities, irrigation works were relatively secured from damage caused by Republican forces (Eysvoogel 1950; Berkhout 1950). '*When visiting several areas after the* [Dutch military] *actions it has struck me particularly, that from the irrigation Works not more was destroyed than was judged necessary for certain military actions, e.g. inundation of large complexes, by the republican troops. Which in my view clearly demonstrates the great value, which the Indonesian attaches to irrigation works*' (Berkhout 1950; 330). Despite these expectations of the Dutch – including many engineers, who perceived their work as being of great value for Indonesia – to maintain good relations with the Republic of Indonesia, relations cooled down considerably in the 1950s.

[1] Part from quote from Herbert Hoover taken from http://www.quotegarden.com/fishing.html

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At the end of the 1940s and beginning of the 1950s it had become clear that the high number of engineers working in the East Indies would not be reached anymore; the East Indies as employment option had disappeared. Many engineers found work with Dutch consultants, a large group of them began a career in development cooperation. Some of them found employment at the universities, as we shall see. When the direct connection between education and employment disappears one can expect discussions about the usefulness of that specific educational program, particularly in engineering. Eysvoogel, responsible engineer for the Sadang irrigation works on Sulawesi, who had just accepted a position as professor of irrigation at the other main supplier of colonial engineers, the Wageningen Agricultural Engineering School, pointed out that quite a few people argued that the study programs directed at the East Indies could be erased (Groen 1988). Within Delft, similar discussions could not be avoided. Despite or because of discussions on continuities, the possibility to graduate in irrigation was maintained in Delft too after 1945. In this paper I explore how this was achieved, what was done in terms of education and what types of irrigation projects were developed by the Dutch in the world. This overview will provide some useful lessons in terms of issues to understand continuities and changes in the international irrigation discourse.

Irrigation and education in the Netherlands before 1945

The link between irrigation education and the prospective working environment in the East was tight in the period after the 1920s, when the Dutch Government even developed specific policies to attract Delft students for working in the Indian colony: selected students could receive state financial support for their last years of study in return for signing a five-year contract for work in the colonies. In the early days of Dutch colonial rule, engineering education did not include dedicated attention for irrigation. When by Royal decision of January 8th 1842 the '*Royal Academy*' in Delft was established (Van Leur and Ammerlaan 1990), irrigation was not yet part of the curriculum. Besides a program for colonial civil servants, the Academy offered five different programs of four years: civil engineering, mining engineering for the colonies, building engineering, mechanical engineering and commercial engineering (Groen 1988). In the first two years of the program, the prospective engineers and civil servants received partly the same technical courses. In the context of the Cultivation System the colonial civil servant was not as much a governor as a production manager (Van Doorn 1994; 113); technical works were executed under his responsibility too, reason to bring technical courses in the civil service curriculum in Delft.

With the application of the new Dutch educational law on June 30th 1864 the Academy was abolished; the new Polytechnic School was established. The monopoly of Delft on educating civil servants disappeared, as programs were established in Delft, Leiden and Batavia (De Jong 1998; Van Leur and Ammerlaan 1990); the civil service program in Delft was no longer part of the Polytechnic. The Department of General Studies became the Polytechnic with six four years courses, including civil engineering. Until 1905 the Polytechnic School was registered as secondary professional education, from that year the School was renamed '*Technische Hogeschool*' ('*Technical Higher School*'; the Hogeschool gained academic status with five year program. Higher technical education had come on an equal level with university education; engineering had become an academic profession in 1905 (Van Doorn

1994). Empirical approaches supposedly were replaced with applications based on physics and mathematics. Nevertheless, '*Even in the Educational Report of 1934* […] *a long argumentation is inserted which includes the remark that in civil engineering and architecture one should not just present based on own experiences (in the lectures; M.G.), but more based on scientific research.'* (Groen 1988; 208).

The Netherlands East Indian Department of Public Works connected itself clearly with the Delft engineering school. In 1874 it decreed that for employment with the Department the civil engineering degree from Delft was obligatory (Van Doorn 1994). Between 1874 and 1878, the Ministry for Colonial Affairs even stimulated the new engineers to seek employment in the colonial service with a grant program for students who would sign a contract for 5 years within the colonial department. This program was a success, at least according to Van Sandick (1911; 200), already quoted on the first page of this chapter. All in all, some 25 to 30 percent of Delft graduates went to the Indies (Van Doorn 1994). Some of them returned to Delft to become professor. The engineers that started their career in the colony did so with a strong Dutch-oriented background. The Delft engineering program did not include much attention for the colony; '*the scientification of technology strongly pressed the element of professional preparation to the background'* (Van Doorn 1994; 117).

Irrigation enters the curriculum

Although the engineers from Delft did not perform too badly in irrigation development from a technical point of view before the establishment of an irrigation course (after all, hydraulic engineering was firmly rooted in engineering education), the call for dedicated attention in the Delft curriculum for hydraulic engineering issues from the East Indies (in particular '*irrigation and other Works in non-flat and tropical regions*' (Van Sandick 1911; 202) remained strong. '*Even when one wants to declare, that for Indian engineers knowledge about Dutch circumstances for the aspects mentioned is desirable too, nevertheless this can never be a reason to leave the Indian terrain, on which they will have to act exclusively, fallow entirely.*' (Snethlage 1890; 427). The pleas for dedicated attention basically focused on arguments in which differences in technical (like soils, climate, building materials) and social (laws and regulations, language, administration) circumstances between the motherland and the colony were emphasized. An added argument was that the civil engineer in the East Indies had to work on his own. He was not participating in a larger team or guided by senior colleagues; no, instead he was often the single technical authority in a large region and responsible for many more tasks than his fellow engineer would be in the Netherlands. The Dutch engineers were no particular admirers of the quality of education for colonial engineers in Britain (compare with Snethlage 1890; 433; Openbare 1892; 25), but their attention for dedicated preparations for service in the colony of their engineers was considered an example to follow (compare with Fasseur 1993). In 1906, negotiations between the Ministry for Colonial Affairs and the Hogeschool Delft resulted in the nomination of a civil engineer on leave from the colony to give the required dedicated course on hydraulic engineering; the course was not obligatory for all civil engineering students. Engineer Grinwis Plaat, who had worked on several locations in the colony on a variety of issues, became the first lecturer. In 1908 his temporary nomination was changed into a permanent position as extraordinary

professor in hydraulic engineering; unfortunately problems with his health made it impossible to fulfill this position longer. On January 1st 1910 Grinwis Plaat retired as professor. In his inaugural speech as successor of Grinwis Plaat, Lamminga stressed that he and Grinwis Plaat considered irrigation as a subject not just important for engineers who would go to the colony. '*On the contrary, I argue that the civil engineer needs to know about this topic as part of hydraulic engineering as much as for example reclaimed areas, polders and such.*' (Lamminga 1910; 4). According to Lamminga, irrigation was important in many regions, including those without water shortage; irrigation was a good instrument to increase production intensities. After a short intermediate professorship of Elenbaas, it was the other grand seigneur of early colonial irrigation Weijs, who fulfilled the professorship in irrigation. Weijs received a regular professorship in 1917; in 1919 his successor Haringhuizen, who had just started in 1917 as professor in hydraulic engineering at the Agricultural Higher School in Wageningen, was the first regular professor to be appointed anew. In 1938 Haringhuizen was succeeded by S.H.A. Begemann, the engineer who had introduced the venturi structure and statistics in hydrology.

Dutch irrigation education after 1945

In the 1930 civil engineering program of Delft only two main graduation specializations could be selected by students: 'Dutch' civil engineering and 'East-Indian' civil engineering, with just a few courses different. In 1955 a prospective engineer could select one of 7 specializations: general hydraulic engineering, polders, irrigation and hydropower, bridges and roads, utility buildings, sanitary engineering and the theoretical specialization (Groen 1988; 263). From these 7 options, the specialization for irrigation and hydropower, '*non-native branches of the practice of a civil engineer*' (Brouwer 1955; 18) was the successor of the East-Indian program. It was the 'Dutch' branch, however, which was really transformed; instead of one general program, six different graduation subjects were defined. One of them was 'polders', which had been a subject in the educational program long before, but remained somewhat hidden. In 1954 Berkhout was appointed as the new professor for irrigation in Delft. He emphasized the need to broaden the perspective of irrigation engineering from the East Indies to all tropical regions, and even to the Netherlands. In a presentation to members of the Royal Institute of Engineers in 1950, Professor Eysvoogel (Eysvoogel 1946) discussed the development of irrigation technology in the Netherlands East Indies; after descriptions of constructive and hydraulic issues encountered, he stressed the attention of Dutch engineers for lay-out, organization and management of irrigation systems. He distinguished two models how these issues were approached: an organizational model based on water distribution to individual farmers and an organizational model based on water distribution to groups of farmers. Leaving aside communist countries and some exceptions to the rule, Eysvoogel distinguished between '*distribution to the farmer everywhere where properties have a reasonable size (thus e.g. in the U.S.A.., South Africa, Australia) and distribution to a group everywhere where small land holding prevails (that is in the tropics).*' (Eysvoogel 1950; 341) In just a few pages, '*tropics*' became equal to '*Javanese*', as Eysvoogel stated that Lamminga had thoroughly studied and defined the principles which had to be applied when designing and constructing irrigation systems in 'tropical regions'.

*'It still has to noted how the founder of irrigation on Java, ir **Lamminga**, sorted this subject out very quickly 50 years ago and defined the principles, which need to be followed when developing irrigation facilities in the tropics. These principles are:*

a. *An irrigation area has to be divided in distribution groups, which are separated by topographical borders. On Java these sawah complexes were called: end units.*
b. *Water distribution to these end units needs to be executed with division structures, which are constructed in such a way that one can control water division completely. Each unit receives water at only one location.*
c. *Discharging excess water from the end units needs to be considered as much as bringing water to the units.*

*As mean unit size 150 ha was selected; that this was a good choice is proven by the fact that, despite proposals for changes, this size has been kept over the years. To these principles one other very important principle was added in the first years of the 20th century by ir **Numans**, namely that both water distribution as maintenance within the unit is the task of all landholders ('ingelanden'), a principle comparable to our water board regulation. Therefore they elect one of their own, whose salary is provided by them together. In Tegal, where this regulation was introduced in 1909, one refers to this representative of the landholders as oeloe oeloe pembagian*.' (Eysvoogel (1950; 342))

In this way, the East Indian irrigation concept was narrowed down to distributing water to smallholders; sugar cane, a crop which played such an important role in Javanese irrigation and influenced the need to control water division is left out by Eysvoogel. In his inaugural lecture Berkhout (1954) pointed out the importance of irrigation worldwide, the need for increased food production and the expertise available in the Netherlands because of its East Indian past. Berkhout emphasized the strategic aspect; allowing the irrigation domain to disappear from the Delft curriculum would mean that on the longer term the Netherlands would not be able to maintain its leading position in the aid programs applied worldwide. Apart from its colonies at that time (Surinam and New Guinea) and the UN-guided development programs, Berkhout saw possibilities for cooperation with Belgium and Luxemburg; Dutch engineers could assist Belgium to develop irrigation in its African colony Congo. Involving Dutch irrigation engineers in the British and French territories would be an option too, as was a return to Indonesia somewhere in the future. All in all, Berkhout was pleased that irrigation had maintained its professorship and that a course in irrigation was obligatory for all civil engineering students. Berkhout re-introduced an argument already mentioned by Grinwis Plaat and Lamminga: providing water to agriculture was an issue in the Netherlands too. Although the shape of irrigation systems in the Netherlands were different, some knowledge of water distribution systems was necessary for Dutch drainage-oriented engineers. Berkhout emphasized that knowledge on technical issues was not enough: water management was at least as important, if not more important. This management aspect of Dutch colonial irrigation was not only restricted to principles of water distribution as such; it was also necessary to consider '*that there a close cooperation existed between the civil servants, the agricultural experts and the irrigation engineers*' (Berkhout 1954; 16).

The successor of Berkhout, professor Schoemaker (professor between 1967 and 1984) did not see any need to defend attention in the Delft civil engineering curriculum for '*exotische waterbouwkunde*' ('*exotic hydraulic engineering*') (Schoemaker 1967), as for him it was clear

that his own appointment already showed that the need was recognized by the university. In his speech, Schoemaker stressed the discontinuities of the educational program and the engineering practice abroad. Discussing available knowledge and applications for several fields, like hydrology, soil mechanics and hydraulic engineering, Schoemaker tried to show that '*a large gulf existed between availability of this equipment and proper use of it*' (Schoemaker 1967; 17). Although at first sight the modern 'equipment' for prospective engineers looked promising for working abroad, the knowledge and applications that were '*trusted and meanwhile reduced to a set of antiques*' (Schoemaker 1967; 12) had not become redundant at all. In his remarks directly made to his future students, Schoemaker acknowledged that the content of his lectures would be one-dimensional and incomplete given the complexities they would be confronted with in their professional work abroad. Confrontations with these limitations during the study program were extremely useful, as it would increase student's capabilities to apply their 'scientifically responsible ingenuity' (Schoemaker 1967; 21). When it was his turn to shed light on the irrigation fields, professor Brouwer, who succeeded Schoemaker in 1985, did not make a fundamental difference anymore between water management in the Netherlands and abroad.

This series of inaugural speeches of Delft's irrigation professors suggest an increasing 'normalization' of the position of irrigation within the civil engineering program; the need to defend the subject within the curriculum seems to decrease. In the period immediately after the Second World War, the position of irrigation in the Delft curriculum had to be redefined and defended. The increasing importance of international development aid provided a welcome new working environment for Dutch irrigation engineers and a new perspective for educating these engineers. In the late 1960's working abroad was well-established; the need to defend working abroad and/or attention for irrigation had disappeared. Real or perceived differences between Dutch and foreign water management situations were gradually minimized as well. Attention for irrigation in the Delft curriculum was not uncontested. Furthermore, Dutch irrigation had come loose from its East Indian roots; the issues to be discussed, trained and solved by irrigation engineers were formulated in general ways, without specific reference to its colonial past.

Dutch irrigation engineers in a new world

The post World War II development aid (or cooperation) programs have indeed brought with them a flow of technical activities for (mainly European and American) engineers in Africa, Asia and Latin America (including former colonial areas). International development organizations under the wings of the United Nations, like the Food and Agricultural Organization (FAO), the World Bank and the Asian Development Bank, were in need for engineering expertise too to develop their projects. Irrigation development was one of the key fields in international aid programs, which were aiming at increasing global food production. Many projects were executed by Dutch engineering firms, who had united themselves in the umbrella-organization NEDECO in 1951. Development aid was an excellent opportunity to maintain the former East Indian specializations and employ those engineers who had worked in the Indies before its independence. '*In this context I call to mind, that the Dutch Government gladly sees offering services to foreign countries and less developed regions in*

engineering too, both in the shape of individueal services as through activities of engineering firms.' (Brouwer 1955; 4). Geographically, the employment opportunities for Dutch irrigation engineers increased; instead of going to the East Indies, their horizon expanded to countries like Bangladesh, India, Pakistan, Nigeria and Colombia.

In 1967 the Indonesian Government applied for international assistance to develop an integrated water development plan for the area. Rehabilitation of existing infrastructure was the first priority; a program including 780.000 hectares in total (with 90% on Java) was formulated. The World Bank with its International Development Agency (IDA) is main financier, which is the reason why the projects included in the program are referred too as PROSIDA (Proyek Irrigasi IDA) (Ravesteijn en Kop 2008). In the context of development aid, Dutch engineers started to work on projects like the Tarum canals and the Djratunseluna area. The activities in this last region, east and southeast of Semarang, are an excellent example of the continuous involvement of Dutch engineers in water affairs. As mentioned before, the civil engineering infrastructure for irrigation and flood protection dates from around 1850. In 1968 a project mission consisting of Indonesian and Dutch experts formulated a general plan. The three Dutch members were all representatives of the link between the Netherlands, the Netherlands East-Indies and Indonesia in irrigation development. Head of the mission was Prof. Ir. H.J. Schoemaker, born in Indonesia and at that time full professor of irrigation at the Delft Polytechnic. With him, prof. Ir. H. Vlugter (former full professor of the Institute of Technology at Bandoeng, than technical advisor of Grontmij N.V.) and prof. Ir. G.A.W. van der Goor (former employee of the Algemeen Landbouwkundig Proefstation Bogor, later full professor at the Agricultural Department of the Universitas Indonesia Bogor and the Gadjah Mada Universiteit Jogjakarta and than working at the International Institute for Land Reclamation and Improvement Wageningen) were other members (Reconnaissance 1968).

Early irrigation Indonesian efforts focused on the constructional aspects, not on management of irrigation systems. Attention for management, however, soon became an issue, as many irrigation systems, which were not rehabilitated for financial reasons could still be improved by improvements in management (which in relative terms would be cheaper). Furthermore, as the population on Java had grown strongly and land use patterns had changed, irrigation systems had to function in different circumstances. Much non-irrigated land (*tegalan* or *pekarangan*) had been transformed into irrigated land (*sawah*), putting more stress on water distribution and management. New projects were started, like the East Java Irrigation Project of 1981, which was aimed at rehabilitation (including management reform) of small to mid-sized irrigation systems (phase I included 58 schemes with a total area of 70,000 hectares, the second phase 41 schemes with 50,000 hectares; one could conclude that small to medium-size schemes are about 1200 hectares) with a total irrigated area of about 320,000 hectares (Vivekananthanan 1987; 154).

Besides rehabilitation, another type of projects can be distinguished with the programs to develop multipurpose reservoirs, usually with feeder canals to supplement water to a series of formerly independent irrigation systems. The Jatiluhur system with its Tarum feeder canals is the forerunner of this type; others have been developed later. The multipurpose Wadaslintang project, from the 1980s and early 1990s, was located in the plains of South-Kedu, south coast of Central-Java. From early colonial times onwards, several irrigation systems were constructed, each deriving water from one of the four rivers in the plains. As in the Citarum Basin with its

East and West Tarum canals, the Wadaslintang reservoir would store water to supply these systems through two feeder canals connecting the systems with a total area of about 35,000 hectares. In November 1982, Dutch NEDECO, the cooperating Dutch engineering firms, became participant in the project, with the task to redesign the Wadaslintang feeder canals. NEDECO indeed proposed some changes: the initial design proposed Parshall flumes in the main system and Constant Head Orifices (CHO) in the other canals. On the Parshall flumes, the NEDECO report states: '*Change Parshall flume in broad crested weir*.' (De Jager 1989; 8). Although the Romijn gate is not proposed, but the preference for a broad crested weir is interesting enough; it is with this type of measurement structure that Dutch engineers were familiar with. The report is somewhat more detailed when the CHO's are discussed: '*At most turn-out locations the available head is large enough for the operation of a broad crested weir. Experiences with this last type of flow meter in Indonesia have learned that it is easier to operate and to construct than a Parshall flume or constant head orifice. Therefore the Consultant proposed to use a broad crested weir as a measuring device for the turn-outs.*' (De Jager 1989; 8)

Comparable discussions on the selection and application of division and discharge measurement structures have taken and are taking place in Indonesia at several locations. Under the umbrella of international cooperation, representatives from different irrigation backgrounds, each with their own technological frame, interacted in the Indonesian irrigation arena. Besides the Dutch engineers, consultants assisting the Indonesian government in irrigation development came from many countries, including Australia, Japan and the US. As Horst (1996) comments: '*Therefore, not surprisingly, they also recommended water division structures that differed from the original Dutch stop logs as check structures and Romijn weirs as offtakes.'* (Horst 1996; 11). Although in colonial times similar discussions on selecting division structures appeared, the difference with modern times is that in these times division structures were not further developed, but taken 'from the shelve', from an available (partial) selection. Haskoning, which we encountered above, became involved in the Punggur Utara irrigation system in Lampung, Sumatra (see also Gany 1993 and 1989). One of the issues was water distribution. The original Punggur Utara scheme was equipped with cross-regulators operated by stop logs in the main system for water level control. Water measurement was done by velocity measurements. In 1983, it was proposed to continue with stop logs in the secondary canals, but use vertical lift screw operated gates in the main canal. Tertiary off-takes would be sliding gates. Within the 1992 rehabilitation project of Haskoning, some amendments were made to this original setup. Haskoning proposed to install automatic cross-regulators of the Vlugter and/or Begemann type and use constant discharge orifice gates as off-takes. The Indonesian Directorate General of Water Resources Development agreed to use the automatic gates, but proposed to replace the off-takes proposed with Crump-De Gruyter gates (Haskoning 2000). This configuration was selected as the design standard.

Concluding remarks

Unlike World War I, which only set a temporarily halt to expenditures, World War II forms a demarcation for the irrigation regime: suddenly the stable working practice in the East Indies disappeared. After World War II, the new political realities caused a major shift in contexts for the Dutch irrigation regime: Indonesia disappeared as main practice. This disruption of colonial realities was not unique for Indonesia and the Netherlands; within 20 years most colonies would

have gained their independence (and were redefined as 'developing countries'). One element of the new political realities after World War II was the growing role of the USA in international policies in general and in water development in particular. The example model of the Tennessee Valley Authority (T.V.A.) became popular; many of the reasons for the success of the T.V.A seemed applicable to the economic situation of developing countries. This larger scale water resources development model did not result in less attention for irrigation development; one of the corner stones of development aid (cooperation) has been facilitating food production through improvement and construction of irrigation infrastructure.

In this new reality Dutch irrigation engineers started to work in other areas worldwide; the first generation did so with their experience in the Indies embodied in their persons, the second generation did so based on their education and training in Delft. As Geels (2002; 323) argues '[…] *diffusion and breakthrough of new technologies depends on wider external circumstances* […]'; the post-War situation provided several '*windows of opportunity*' (Geels 2002; 323). Dutch engineers started working in other tropical regions, engineers from different countries started to work in independent Indonesia. The windows of opportunity, however, remained closed for a long time in the irrigation education program in Delft. Although the new working realities for Dutch irrigation engineers were explicitly taken into account to defend continuation of the Delft irrigation program, irrigation engineering in Delft remained to be approached as the application of several design prescriptions from the technological frame developed in the Netherlands East Indies. Becoming active in an international context provided the forum for new experiences, as it did bring with it confrontations with the design approaches of other irrigation areas, both in Indonesia and other regions.

As other networks of interaction, engineering communities show a certain degree of relative stability enabling as well as constraining engineers in their actions. Recognizing this may not immediately lead to improvements in irrigation system design, but understanding processes which bring about designs is a first step to take anyway if one would like to improve them. Similar words were spoken by professor Brouwer in his inaugural speech: '*It is important that we realize that* [in operational water management] *we are not dealing with a mathematical-hydraulic problem, but with the fact that new insights and methods need to root with the designers and water managers who are working in practice. Convert a systematic grown and established during many generations and based on stationary flow calculations and fixed control instructions towards designs based on dynamic simulations and dynamic control on effects measured in real time, demands apart from thorough research into what is possible a thorough introduction using test projects, demonstrations and training and education. A beginning with this has been made, but it is just a first start.*'

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