

Technology transfer and water sustainability - Experiences of Japan

Nobumasa Hachio & Yutaka Matsuno
Kindai University
Japan



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Technology came with migrants

- Technologies came **in a package** with people who already had know-how of utilizing them.
- Massive inflow** of migrants
 - Mixed with indigenous people (Jyomon)
 - Some say more than half had origin of migrants at about 150 AD. (Pop. 600,000)
 - No big confrontation between migrants and Jyomon people.
- Enormous impacts** of cultivating rice:
 - Hunting & gathering → rice cultivation → population increase(0.35-0.4%/year)
 - accumulation of wealth → Formation of a state (Yamato court: 7th century.)



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Technology Transfer

- New/innovative technology**
 - From Developed to Developing region/country
 - Source of innovation and productivity improvement
 - Big impact on development
- Process of digestion**
 - Transfer → internalization (digestion) → Implementation → Improvement
- Case of Japan**
 - 1st wave** : BC 3rd century – import of rice cultivation technology
 - 2nd wave**: around 7th C.A.D. – Irrigation related technology
 - Internalization process and Isolation of the country
 - 3rd wave**: technology import from Ming or Ching dynasties (mid 18 C)
 - 4th wave**: After Meiji restoration (1968~) Modernization



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Migrants from China and Korea

Kadono-Ooi (large weir) in Kyoto, built latter half of 5 C by Hata Uji



Ichinoi-seki at Arashiyama, Kyoto

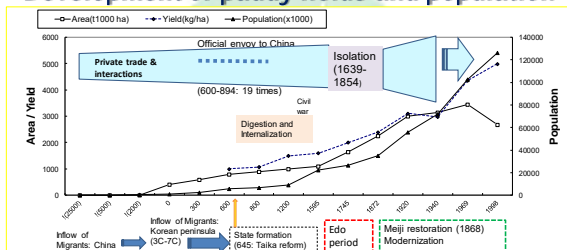


Intake from Katsura river



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Development of paddy fields and population



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Official envoy to China

- Tribute to Chinese Dynasties** (Zui and Tong)
- Recognized as one of tributary country
- Many priest and scholars** sent by the State (19 times in 200 years)
 - Very dangerous ventures to travel.
 - Advanced technologies : iron making, farming and engineering technologies
 - Religion (Buddhism), writing system (scriptures), calendar, and governing system
- Private trading of goods and materials continued even after the closure of official envoy.



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Priests who worked for irrigation system

- **Gyoki** (668-749); 2nd generation of Korean migrant
 - Learned Buddhism and engineering (to save people) from Dosho(official envoy)
 - Master of Dosho is Xuanzang (travel to India for scriptures: Journey to the West)-Monkey King
 - Construction and rehabilitation of irrigation system(Sayama Iike: WHIS 2014 registered, Kumeda Iike: WHIS 2015 registered, etc.), canals, bridge or port.
- **Kukai** (Official envoy in 804-806)
 - Rehabilitated **Manno pond**(2016 WHIS registered) in 852 (3,000 ha irrigated)



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School of Samurai engineers

- **Kanto (Ina) School**
 - River training works: open levee, over flow levee, retarding basin
 - Controlled the flood by storing the flow within the winding river channels
 - Kasai irrigation system around 1660 (water source: water storages)
- **Kishu School** (Shift from Kanto school in early 18th C)
 - Abolished open levee or overflow levee
 - Straight river channels by providing stronger river embankment.
 - High and continuous river levees
 - Intensive paddy fields development in the middle and downstream of the river
 - **Minuma Dai Irrigation system** (1728:WHIS nominee 2019)
 - direct water withdrawal from a major river (larger volume)
 - separating irrigation and drainage canal
- Paddy field expansion: 1.1 million ha (mid 15th C.)→ 2.6 million ha.(1872)



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Localized development in the Medieval Ages

- **Transition period** (9th - 15th C)
 - National land and water management to private control
 - Central state to nobility, temples and shrines, and warriors (Samurai)
 - Not much area expansion (0.9 million ha to 1.1 million ha)
 - Improvements in water delivery and management as well as construction of small reservoirs (abandoned land or unused land put into cultivation)
 - **Samurais and local landowners** gained political power and established their government in Kamakura in 1192.
 - Integration of political, economic and military power by feudal lords (Samurai leader) lead to the integrated management and development of water



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Farmer and merchant initiatives

- **Transfer of technology** from Samurai class to farmers (Sharing)
 - **Earthwork groups** called 'Kurokuwa' (after mid-18th C.), engineering contractor
 - Development of new paddy fields by contracting from feudal lords
 - Hyakusho Yoriai Shinden (farmer group), Chonin Ukeoi Shinden (merchant contracting)
 - **Jikkokubori irrigation canal project** (WHIS nominee 2019) by the village leader in 1668
 - **Fukara Irrigation canal** (1680:WHIS 2014 registered):
 - merchant contract (village leader initiative with cooperation from wealthy merchant)water from Ashinoko Lake with a tunnel of 13 km, mobilization of 834,000 labour-day in 4 years
 - **Meiji Yousui Irrigation system** (WHIS 2016 registered)
 - Merchants initiative, completed in 1880



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Samurai engineers

- Advanced **water control technologies imported from China** (13 & 14 C)
 - accumulated during **Sung, Yuang and Ming** dynasties.
 - development of large rivers and their delta area
- **Daimyos** (Feudal lords) (15-16 C)
 - Consolidate **economic base of their domain**
 - **Castle building and mine** development tech.
 - engaged in large-scale agric. development by **flood control and irrigation**
 - **Shingen Takeda** (1521-1573): food control by Shingen levee



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Foreign advisors (Meiji period~)

- **Meiji government** (1868~)
 - invited foreign advisors from European countries and U.S.A.
 - nearly 10 thousand invited foreign specialists (~about 1900)
 - hired by Meiji government or private sector
 - **Johannes van Doorn** (~1872 from the Netherlands)
 - plan for **Asaka irrigation project** (WHIS 2016 registered) (1880-1883)
 - trans-basin water transfer from Inawashiro lake: irrigate 2,000 ha + supplementary water:3,200ha
 - **Rouwenhorst Mulder** (the Netherlands) (in Japan1880-1890)
 - made plans for river and harbour improvements as well as Kojima reclamation project.
- **After the WWII**
 - Hachigotata polder reclamation: Prof. Yangsen from Netherlands and engineer Folker (Delft Institute of tech.)→ Yangsen report in 1954



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Discussion: Technology transfer and digestion

- Four important elements
 - 1) **packaged technology**,
 - 2) **participation and knowledge sharing**, (Samurai to farmers, Foreign advisors to government engineers...)
 - 3) **lessons from failure** (learned from experiences: Sayamaike),
 - 4) **Institution** (schools of Samurai engineers)



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Conclusions

- **People** involved in
 - bringing in the technologies,
 - digesting and implementing them systematically,
 - integrating them into systematic engineering (schools)
- With the participation and devotion
- Lessons:
 - integrated technology package, knowledge sharing, learning lessons from failures, and institutions
- Japanese land formulated
 - Constant efforts of people, for improving the livelihood



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