**Adoption of New Technology for Charcoal Production**

**in Palestinian Villages near Jenin**

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**1 Introduction**

**1.1 Background**

The Palestinian villages in the Jenin area in the West Bank are under the civilian rule of the Palestinian Authority (PA), and, since the 1967 occupation, under Israeli military rule, as a colonial government (hereafter, Israeli rule). The Civilian Administration is an Israeli military body whose role is to communicate and coordinate with the PA, and to ensure an improved quality of life in the region for the benefit of the Palestinian and Jewish populations. The Israeli-Palestinian relationship is complex, and includes tension and power struggles, along with close daily collaboration.

The traditional method of producing charcoal has been one of the main sources of income for the residents of the villages in the Jenin area for many years. This production method does not require education, but rather experience and skills, which are passed down through the kinship groups (‘hamula’ – extended family) in these villages from generation to generation. In 2010, over 300 charcoal production kilns operated in open lands near the residential areas of the villages in the Jenin area (Fig. 1), employing ca. 18,000 people. Most families operated one charcoal production kiln (hereafter, kiln), but some operated up to six kilns. The stronger kinship groups, with higher socioeconomic status, operated a larger number of charcoal production facilities and wielded greater control in the industry. The kilns employed men, young adults and children who were recruited for the different roles in operating these facilities: regulating the fires, guarding, breaking the finished charcoal, packing, marketing, etc. (Fig. 2). For some, this was their only employment, while others also had other sources of income. The charcoal production process takes at least 25 days, more in the rainy season. Treatment and guarding were required constantly around the clock; thus the work was performed in shifts. An employee who worked for a month at the kiln could earn up to $560. The operating costs of the kiln were ca. $6,400 and included purchasing the wood, transportation and wages, while the profit from each kiln was ca. $3,600 (from an interview with K.M., 2016).

Approximately 50–60 thousand people live in the Zabed region, known for generations for its two main products: charcoal and cigarettes. In contrast to the relatively clean cigarette industry, the charcoal industry caused severe air pollution that resulted in significant harm to PA residents and Israelis who live near the kilns and downwind of them. In addition, charcoal production caused soil pollution in the vicinity of the kilns and damaged local agriculture. Together, these factors led to a high local mortality rate relative to the national Israeli average and to the mortality rate of Palestinians in other parts of the country. The general mortality rate (per thousand) in 2012 in the village of Zabed was 6.5; slightly to the east, the mortality rate in the villages of Kabatiya and Tamon was 5.0 and 5.4, respectively (PCBS, 2013). The average mortality rate in the West Bank was 3.9, while the mortality rate in Israel was 5.3. Similarly, the average incidence of respiratory diseases in this region during that same year was 5.2 per thousand (CBS, 2012), while in Zabed it was 5.8 per thousand (PCBS, 2013).

Following the merging of several opposing petitions (Israel against Palestine and Palestine against Israel; 7677/10; 3682/11; 4674/11; 4745/11; 7804/11; 9547/11; 2277/12; 969/12 – Naor et al., 2012), which were debated in Israel’s Supreme Court, the Civil Administration (CA) was required to intervene in the charcoal production industry in the Jenin area and the surrounding villages. The first petition, which was submitted to the High Court of Justice in 2010, demanded immediate cessation of the operation of the kilns due to the air pollution that resulted from the charcoal production process. A number of other petitions were then submitted, demanding that the CA find a creative solution to prevent the loss of a traditional source of income for the area’s residents, on one hand, and to prevent air pollution, on the other.

In 2016, the CA invited researchers from the Center for Regional Development, supported by Israel’s Ministry of Science, to develop and build kilns using new technologies that do not cause air pollution, and assisted in introducing them in the Abiara – Qeiqis region. At first, researchers sought to design new kilns that would reduce emissions by 90% and increase efficiency; the final design prototype is a kiln that produces charcoal with zero emission of pollutants. Israeli and Palestinian researchers fully cooperated in the development of the kiln over the course of approximately two years.

The new kiln is based on technology that doubles charcoal production, minimizes the production time from ca. 25 days to only 12 hours and enables the production of two tons of charcoal in each operation (in the Zabed prototype). Another improvement was the amount of successful charcoal obtained with each operation; while traditional kilns only yielded 15% usable charcoal, the new kilns promised a success rate of 35–50%. Since there is a limited amount of pruned branches (i.e., cut wood) in Israel and the PA, this increased efficiency reduced the number of kilns required to process all of the raw material and the number of employees. To increase the chances that local residents would adopt the new system, additional economic benefits were integrated into the process: wood vinegar, a byproduct of charcoal production, which was produced at a rate of 30% of the wood fed into the system, is known in its concentrated form as tar (itran – قطران), and intended for a range of uses such as paint, flavoring, treating camels and horses and cosmetics; and flammable gas (syngas), emitted at the end of the kiln process, that can be used for the independent production of electricity in areas without a regular supply. This paper aims to document the changes that took place in the Palestinian villages in the Jenin area following the introduction of the new kiln and the consequences for social and political relationships and the local economy.

**1.2 Adoption of new technologies in traditional societies**

Studies have documented the positive benefits of technological change on developing societies. Examples include the adoption of new technologies to conserve soil and water, which contributed to reducing poverty in Africa and South America (de Graaff et al., 2008; Loevinsohn et al., 2013; Mwangi and Kariuki, 2015); genetically engineered cotton that improved the lives of Indian farmers (Padaria et al, 2009); and cellular technologies that contributed to the wellbeing of villagers in Nigeria (Aker, 2010) and Sri Lanka (Jayathilake et al., 2018). Different terms are mentioned in the literature to describe the acceptance of new technologies by individuals, groups and companies, including ‘technology diffusion’, ‘technology acceptance’, and ‘technology adoption’. Technology innovation is “a new alternative or alternatives, with new means of solving problems” (Rogers, 1962, p. xviii) (Rogers, 1962, p. 36). Technology adoption could be defined as “the acceptance or the first use of an emerged technology or product” (Rad et al, 2018).

One of the prevailing theories to describe the gradual process of adopting a new technology by an individual or group is the Diffusion of Innovation theory (DOI) (Rogers, 1962), which describes a five-step process: knowledge, persuasion, decision, implementation and confirmation from the social surroundings. According to the DOI theory, the last to adopt can also benefit the most from a new technology.

Another model that has been used extensively is the Technology Acceptance Model (TAM), according to which ‘perceived usefulness’ and ‘perceived ease of use’ influence the desire to actually use the technology (Davis, 1993; Rose and Straub, 1998). Venkatesh and Davis (2000) expanded this model to include a consideration of social norms and reputation – in other words, whether adopting the new technology improves users’ social status – as influential factors. Another theoretical development, the Unified Theory of Acceptance of Use of Technology (UTAUT), focuses on the effect of effort expectancy and performance expectancy, and the social effect – the level of support by influential stakeholders– on the adoption of technologies (Venkatesh et al., 2003, 2012).

Several empirical studies have combined the abovementioned theories and the theory of Hofstede (2001) to describe the adoption of technologies in non-Western societies (e.g., Li and Ho, 2015; Kurnia et al, 2015; Dajani and Yaseen, 2016; Rabaa’i, 2017; Zhao et al., 2018). Hofstede (2001) identified cultural dimensions that promote or delay adoption of technologies in different cultures. For examples, hierarchical societies that are more tolerant of unequal division of power tend to have higher power distance (PDI) and collectivism (IDV) indices, more long-term orientation (LTO), display intolerance to uncertainty (i.e., the uncertainty avoidance index – UAI), and tend to delay the adoption of new technologies or to prefer less risky technologies (Veiga et al., 2001).

Hofstede’s critics opposed his presentation of national cultures as homogeneous and his disregard of subcultures by, for example, presenting most non-Western cultures as tending to collectivism (Leidner and Kayworth, 2008). Hill et al. (2008) focused on more specific cultural factors in Arab societies: the community-collectivist dimension is expressed by the importance of extended kinship groups, which provide support and identity and demand commitment to group decisions. Status hierarchy, loyalty to the family, religion, tradition and social structure can hinder the adoption of new technologies and overpower the effects of education and age. Although Middle Eastern societies have been found to have a high PDI, a tendency for collectivism, avoid uncertainty, are less oriented toward the future, and are affected first and foremost by familial and social-status structure with respect to technological adoption (Andriani and Sabatini, 2015; Dajani and Yaseen, 2016; Rabaa’i, 2017; Ameen and Willis, 2018). Nevertheless, it has also been found that more and more Middle Eastern societies are developing an increasing tendency toward individualism and a readiness to accept uncertainty, contributing to the adoption of new technology (Ameen and Willis, 2015, 2018; Rabayah, 2019).

The adoption of technologies in developing societies is significantly different than in developed societies. Tendencies toward collectivism, avoidance of innovation and intolerance of uncertainty have been found to delay technological acceptance in Ghana and Nigeria (Eseonu and Egbue, 2014); preservation of traditional social networks alongside tendencies to collectivism have been shown to have a similar effect in Fiji (Zhao et al., 2018). In many developing countries, members of the dominant elite enjoy connections with the government and higher education and are more exposed to technological innovations. Having at their disposal financial resources and land, coupled with their ability to recruit manpower and their access to transport, encourage them to adopt new technologies (Shaw, 1987). Thus, for example, the concentration of power in the hands of the rich elite in Ghana and Nigeria harms technological adoption by the poor majority (Eseonu and Egbue, 2014). It has been found that adoption of new green energy technologies in both Africa and Central Asia is influenced by proximity to the geographical center, socioeconomic status, family size and level of education (Eshete et al., 2006; Mwirigi et al., 2009; Padaria et al., 2009; Kabir et al., 2013; Uhunamure et al., 2019). Gender effects have also been found. For example, male heads of families in Africa tend to adopt agricultural technologies more than women, due to better access to resources (Shaw, 1987; Mwangi and Kariuki, 2015; Mengistu et al., 2016). Studies from Africa, India and Iran have emphasized the importance of the social network for mutual learning and support in the process of introducing agricultural technologies (Mwangi and Kariuki, 2015). In contrast, it has been found that obstruction to technological adoption includes conservative attitudes, absence of knowledge and skills and difficulty in obtaining government support (Sharifi et al., 2010; Mugonola et al., 2013).

**1.3 Shifts in the Arab-Palestinian village**

Over the past several decades, Arab-Palestinian villages, which have existed for centuries relatively unchanged in Israel and in the West Bank, have undergone a process of transformation into modern, hybridized urban villages (Barur, 1994; Khamaisi, 2013; Alfasi, 2014).

Nevertheless, the change has not been uniform, and in more peripheral areas, such as the villages of the West Bank. The main cause is the socio-cultural structure of the kinship group, characteristic of Palestinian and Middle Eastern society, which maintains blood ties, residence and membership of an extend family (Khamaisi, 2013).

Processes of urbanization and industrialization have encouraged nuclear families to find independent sources of income, in many instances outside of their villages, and separately from the extended kinship group. These economic changes, which were accompanied by an increase in the level of education of many young adults, weakened the financial strength of the kinship group, promoted the economic independence of the nuclear family, and contributed to the weakening of kinship identity (Haj-Yahia, 2019).

In addition to its economic role, the kinship group serves as a source of authority and identity, and acts as a basis for political organization and power struggles between strong kinship groups and weaker ones, and between central and peripheral branches. The political power of the strong kinship group in Arab towns in Israel is expressed by its influence on municipal elections and the choice of local council heads (Ben-Bassat and Dahan, 2012). Despite the changes in kinship structure and new possibilities for social mobility, the kinship group continues to serve as a source of primary support and identity in Palestinian society, based on loyalty, emotional connections and shared values (Haj-Yahia, 2019). Studies focusing on the socio-political structure in the West Bank have emphasized the political solidarity of the strong kinship groups and participation in anti-Israel movements (Harker, 2011, 2012; Hoigilt, 2016).

Recent economic developments in the West Bank are reflected in the unequal division of income and the exacerbation of social polarization between rich families and the majority of low and middle income families. Despite economic growth, many young adults remain unemployed and poverty is not decreasing (Khalidi, 2019). Since Israel’s evacuation from Gaza in 2006, the large, rich elite families in Gaza lost their power to the new political and economic leadership, as they promise economic protection and security to all their friends (Robinson, 2009; Khalidi, 2019).

The focus of our study was an attempt to introduce new technology into a community with a kinship-dominated social structure tending toward collectivism and social hierarchy, in the complex reality of life in the West Bank.

**1.4 Research Aim**

This study aimed to examine the initiative for change that was forced on the residents of the Palestinian villages in the Jenin area who earned their living from charcoal production by traditional methods, and the consequences of this initiative. The study interviewed residents at different points in time during the three-year period from 2016 to 2019, and presented their attitudes towards charcoal production and its effects on their health prior to the closure of the kilns. The study examined the complexity of the social and political relationships among kinship groups, the PA and the CA during the attempt to introduce new, clean kilns.

The research team included Israeli and Palestinian researchers, most of whom are completely fluent in Arabic. Conversations with kiln owners, workers and other residents took place mainly Arabic, in some cases through an interpreter. The study was conducted in three main stages: in the first stage, the study’s steering committee, which included two Jewish researchers and one Palestinian researcher, created a questionnaire that was translated into spoken Arabic. Four Palestinian students commented on the content and wording of the questions, assisted in developing the final questionnaire, and distributed the questionnaire in their village and in Zabed. In the second stage, participant observations were made during the attempt to introduce the new kiln, which included construction of the kiln in Zabed and interactions with the kiln managers, representatives from the PA and the CA. In the third stage, in-depth interviews were conducted with key figures connected to the process: the two ‘contractors’ – developers of the new kiln – a Palestinian and an Israeli, four Palestinian kiln owners and three managers from the CA.

**2 Methods**

**2.1 Research tools**

The survey included 25 questions: some were demographic while others related to employment and work in the kilns, the kilns’ connection to health hazards and the state of health. The questionnaire was approved by the ethics committee of the university. The study also relied on legal documents and popular articles related to air pollution, kiln operation and opposition to change. Some observations were conducted in the construction area of the new kiln in Zabed during the construction process, while others took place during structured interviews that were arranged with people who were invited to operate the kiln. Approximately 30 in-depth interviews with key figures were conducted in the researchers’ office or at the study site at three different points in time, according to the research stages.

**2.2 Research process**

For the purposes of the survey, all households in each village were mapped and systematically documented. The surveyors received detailed training in conducting interviews and the sampling process from their supervising researcher, and received payment for their work. The sampling process followed the systematic random method, as follows: a number of streets/areas were chosen in different villages. In each village, the surveyors approached every third house on a previously compiled list. In each sampled household, surveyors asked one male family member to answer the questionnaire. The selection of the respondent depended on availability and a desire to obtain different opinions from within the village. In other words, sometimes researchers interviewed teenagers or young adults who worked in the kilns, and sometimes the head of the family, or men who did not work in the kilns (non-kiln workers). When the respondents did not know how to read or write, the surveyor read out the questionnaire to them in Arabic and marked the answer according to their choice. In total, 326 respondents from different households answered the questionnaire; 62 of them reported on earning a living from the kilns, while another 264 reported that they were employed in jobs not connected to the kilns, but other family members do earn a living from the kilns. The names of the villages, kinship groups and respondents were modified to maintain anonymity.

**2.3 Background characteristics of the sample**

The respondents includes 227 residents from Zabed, 56 from Al Tura and 40 from A Rad. The overwhelming majority of the respondents live in the vicinity of the kilns. Of these, 21.7% live in close proximity to a kiln, 60% live within 2 km of a kiln and 18.3% within 10 km of a kiln. The age of the respondents ranges from 11 years to 71 years (mean (M) = 33.2; standard deviation (S) = 12.3). With respect to family status, approximately 56% of the respondents are married, 38% are single and 6% are children. Large gaps in education were recorded among the respondents: 7% have elementary education, 9.6% have middle school education, 42.1% have high school education and 36% are university graduates. The respondents’ average number of years of education is 11, with large variation among them (S = 3.7). The number of children per family ranges from 0 to 12 (M = 3.7; S = 2.5). Among kiln workers, the age of commencing work in the kiln ranges from 10 to 25, with an average of 17 (S = 3.7). Among the group of respondents who do not work in the kilns, 45 are employed in agriculture, 42 earn a living from teaching, 23 from commerce, 16 from construction, 23 are students and 12 are school children. The others are salaried or self-employed as high-tech workers, accountants, doctors, drivers, laborers and more. Eleven respondents are unemployed. Half of the respondents indicated that their family income does not exceed $1,000 and only 2.7% reported a monthly family income of at least $3,000.



**Fig. 1** Traditional kiln ready for activation and a cluster of kilns at different stages of operation.

**Fig. 2** Palestinian men work at a charcoal factory in the northern West Bank village of Yabad

(AFP/Getty Images/Saif Dahlah, 2011)

The average number of years of education of non-kiln workers (M = 12.03, S = 3.84; p<0.05) is significantly higher than that of the kiln workers (M = 10.60; S = 3.29), and they work significantly more hours (M = 6.20; S = 3.19) than the kiln workers (M = 4.69; S = 3.04). The salary of the kiln workers (M = 4.69; S = 3.04) is significantly lower (p<0.01) than the salaries of non-kiln workers (M = 3.04; S = 3.18).

**Fig. 3** Map of the distribution of charcoal kilns in Jenin before (red) and after (black) enforcement of kiln closure commenced in 2012

**3 Results**

**3.1 Residents’ attitudes towards charcoal production**

A comparison between residents of the villages in the Jenin area who work and earn a living from the kilns and non-kiln workers shows that there is a significant difference between their estimation of the health hazards resulting from proximity to the kilns (see Table 1). There is relative consensus among non-kiln workers that proximity to kilns has a moderate to high effect on health, particularly on the respiratory system, while kiln workers believe that the health hazard of the kilns is moderate but also relatively higher than other health hazards. The significant difference between the groups (kiln workers vs. non-kiln workers) and the relative uniformity within groups were also found for the other health variables examined. Non-kiln workers estimated that proximity to the kilns carries a moderate risk of various types of cancer, respiratory problems, severe skin problems, severe damage to internal organs and rapid aging. In contrast, the kiln workers estimated the risk of such health hazards as relatively low, and significantly lower than the estimates of non-kiln workers.

|  |  |  |  |
| --- | --- | --- | --- |
| State of health | Place of work | Mean | Standard deviation |
| Harms general health | Kiln  Other | 2.98  3.56 | 1.01  1.19 |
| Life-endangering | Kiln  Other | 1.78  3.01 | 0.98  1.36 |
| Causes types of cancer | Kiln  Other | 1.96  3.00 | 0.90  1.16 |
| Respiratory problems | Kiln  Other | 3.09  3.74 | 1.20  1.08 |
| Severe skin problems | Kiln  Other | 2.13  2.77 | 0.99  1.07 |
| Severe problems to internal organs | Kiln  Other | 1.90  2.70 | 0.90  1.20 |
| Rapid aging | Kiln  Other | 1.96  2.77 | 1.06  1.28 |

\*Rank 1= lowest estimate; 5=highest estimate; level of significance p<0.01

**Table 1** Estimated health hazards from charcoal production work\*

Likewise, with respect to environmental pollution, non-kiln workers estimated the polluting effect of the kilns as being high, while the kiln workers estimated the polluting effect as only moderate (Table 2). Non-kiln workers estimated the short- and long-term polluting effects of the kilns as moderate to high, while the kiln workers estimated these polluting effects as moderate.

|  |  |  |  |
| --- | --- | --- | --- |
| State of health | Place of work | Mean | Standard deviation |
| Pollutes nearby environment | Kiln  Other | 3.01  4.01 | 1.12  1.09 |
| Pollutes distant environment | Kiln  Other | 2.44  3.33 | 0.98  1.21 |
| Short-term pollution | Kiln  Other | 3.11  3.77 | 1.17  1.19 |
| Long-term pollution | Kiln  Other | 2.90  3.60 | 1.25  1.26 |

\*Rank 1=lowest estimate; 5=highest estimate; level of significant p<0.01

**Table 2** Effect of traditional charcoal kilns on the environment\*

Kiln workers’ estimates of the risk and harm to themselves and their environment from their work in the kiln were lower than those of non-kiln workers for most variables. We assume that the attitudes of the kiln workers are influenced by the need to safeguard their source of income as an existential need. We also assume that their allegiance to an age-old tradition, as practiced by previous generations, gives them a feeling of security in a familiar environment that decreases their perception of danger (Billig, 2006); any change to this environment is a threat and a cause for concern. It appears that the dependence of kiln workers on the owners of the largest kilns and their loyalty to them also influences their opposition to stopping work in the traditional kilns, in contrast to the attitudes of their employers, as described below in the in-depth interviews. Conversely, non-kiln workers are involved, by virtue of their different professions, with the urban Palestinian and Jewish populations (Haj-Yahia, 2019), connected to knowledge from around the world, and more aware of the consequences of the traditional kilns on air pollution, and thus on their health. Although they personally opposed the kilns and wished that they would close, they avoided leading change themselves due to their membership in the existing kinship structure, as many of their family members earned a living from the kilns.

**3.2 Manipulations and interruptions to the establishment of the new kiln**

Despite the advantages of the new kiln, the decision to install it in an area where the charcoal production industry existed near Zabed encountered considerable opposition from the strong kinship groups in Zabed, Abed Al Kabir and Abu Jalid. This opposition was expressed by the use of different manipulations to influence the decision-making to their own advantage. We will now describe a number of representative events to demonstrate how this method worked.

Ans Badawi, the Palestinian contractor who was appointed to construct the kiln, believed in the project and considered it a new economic opportunity. Badawi, a resident of a town near Kalkiliya, was educated in constructing engineering projects and had no previous familiarity with the residents of Zabed or with the relationships among the kinship groups in the region. Due to his command of Arabic, professional understanding, patience and good negotiating skills, he was a natural mediator between the development staff and the kiln operators and at times even tried to mediate between the CA, the PA and the research team. The first difficulty that Badawi encountered was in identifying a site to construct the kiln, since most of the landowners along the Zabed-Zabeda route opposed its construction on their land. As Badawi described:

I was not familiar with the people of Zabed, they sent me to Hamudi Al Hajj. I went to him. I told him that I am going to make him a kiln. He answered: “Do you think this is the right time?” I told him to give me land to work on and I won’t need anything from him. He gave me a spot in the lowest part of the land… He said: “This is the place I want you construct the kiln”… we began to dig, we worked for eight days [and] it was no good… all of the drainage of Zabed comes there… we ordered a tractor from the Zabed municipality… he drove us crazy and said: “Don’t touch here… it’s a pile of hay from WWII and I need it”… I went out of my mind… and then Ra’ad came and said to me: “Come here I’ll give you better land” and took me to a good place with a better type of soil… within half an hour a tractor came from the municipality… after two hours everything was ready… the next day we constructed the building and progressed well… then we waited for the gas system… it took us 20 days to receive the gas…

The consent of Achmed and Ra’ad from the Abed Al Kabir kinship group to allow construction of the kiln – first in one area and later in another – was surprising, since they are two of the largest importers of charcoal from Egypt, and probably used the tactic of time wasting and increasing production costs to wear down the contractors in the hope that they would abandon the project. Eventually the kiln was constructed on land belonging to Hilal Kiss, who is connected to the Abed Al Kabir kinship group but is not part of it, and expressed interest in its operation. The members of the Abed Al Kabir and Abu Jalid kinship groups accompanied the construction project and were involved in the construction process, probably in order to identify its weak points. In parallel, attempts were made to damage the new charcoal production facility and Hilal Kiss was warned not to operate the kiln on a regular basis.

A number of trials of the kiln were conducted in order to identify faults and fix them accordingly. The first attempt to operate the kiln was not successful; its opponents claimed that this proved that the charcoal was not suitable for use. On the second attempt, traditional kilns in nearby were also lit and photos were sent showing the resulting smoke, with the caption: “See how much smoke the new kiln makes”. During the more successful third attempt, the same fabricated photos were distributed among members of the PA and the CA who frantically called the researchers and demanded clarification, until the sharp eye of the chief researcher identified that these were actually the old, false photos distributed by the opponents from Zabed. On the fourth, attempt the kiln managed to meet its targets and the kiln owners were impressed with the result, as described by Badawi:

…this time everything went well and excellent charcoal was produced. A rumor spread very quickly and at ten o’clock people began arriving with food, candies and coffee; they made a real celebration because they were very happy! But then Ra’ad came and said: “It’s not good!!”… 200 people said the charcoal was excellent… even the elders said: “What great charcoal, we never saw such good charcoal” – but Ra’ad kept saying the charcoal isn’t good! In contrast to the traditional method, in which 75% of the charcoal in each operation was waste… no waste came out of the new kiln at all. It was not easy to get a ‘Wow’ from the kiln owners after their one million four hundred questions; I was happy that we had finally succeeded…

Approximately 12 hours after the first operation of the new kiln, all stakeholders were invited to a meeting by Sami, a Druze commander from the CA. The meeting participants included approximately 15 owners of large kilns, representatives of the PA, the Zabed Council Head, representatives from Israel’s Ministry of Agriculture (MOA) and CA, the development team and the kiln construction team. The aim of the meeting was to summarize the initial operation of the kiln and discuss the quality of the charcoal and the introduction of the system, with the aim of arriving at an agreement. Each of the representatives of the participating bodies was asked to present his perspective. A representative of the PA opened the discussion, and the meeting continued as follows:

After a round of talking, the kiln, which had operated previously without smoke or smells, was operated again, and it was clear that everything was working smoothly. At this point the opponents of the new kiln peeked through the holes and shouted: “The charcoal isn’t good!” After opening the kiln they removed some pieces of charcoal that weren’t completely ready from the pile of charcoal in the upper part of the kiln, put them aside to cool down and then grabbed bags that they brought with them to the meeting that contained good charcoal which they said had been produced by the traditional method. With great emotion they passed among the meeting’s participants with the bag in one hand and the new charcoal in the other hand and personally showed them the differences: *“Look with your own eyes, there is still some red color at the back which means that the charcoal still isn’t good. Your charcoal doesn’t break well at all! Look at our charcoal, it’s heavier and breaks easily… it’s unbelievable what poor charcoal is produced by the new kiln!* *They’re not even good enough for hookahs, which require better quality charcoal*.”

We note that the charcoal produced in the inner layers of the new kiln was usually of high quality, but the samples that were removed to show to the meeting’s participants were taken from the upper lay in which the charcoal was not yet ready, and were compared to the best charcoal from the traditional kiln, as was clear to everyone. Badawi and the researchers who accompanied the process were surprised. They were aware of the other difficulties created by the Palestinians but had not prepared themselves for such a display. Moreover, the reports on air pollution were, in their words, ‘fabricated’ but could not be contradicted because intentional disruptions to the internet at the site prevented the researchers from issuing alternative reports. The ‘display of evidence’ produced by the traditional kiln owners from the strong kinship groups was impressive and convincing, although the deceit was transparent. ‘The battle for scientific truth’ used scientific language, and this disagreement – which was never settled – was led by the educated members of the kinship groups and the researchers, emphasizing their command of knowledge and technological advancement. The explanations provided by Badawi and the researchers were suppressed by their opponents shouting ‘the established facts on the ground’. The researchers who thought they could convince the kiln owners and the members of the PA of the efficacy of the new kiln encountered unexpected counterpropaganda.

The success of the Abed Al Kabir and Abu Jalid kinship groups in stopping the operation of the kiln time after time highlighted their control of the situation and emphasized their power in the face of this new challenge. Using a range of different methods and ‘languages’ of intimidation – professional-scientific and economic-political – the kinship groups prevented the introduction of the new kilns in the village without open confrontation with the authorities. Simultaneously, the kinship groups strengthened the perception of their own invincibility among the region’s residents. As a result – although a number of kiln owners from other kinship groups in Zabed and villages in the area approached the members of the CA and expressed great interest in the new kiln and the economic opportunities it promised, some of whom even suggested moving the kiln to their land – they withdrew rapidly because their concern about opposing the dominant kinship groups overcame their interest and desire for change.

**3.3 Joint interests with the Palestinian government**

The representatives of the Palestinian government are aware of the limits of their sovereignty due to Israeli control, and function within the framework of these limitations. The leading kinship groups in cities and villages in the West Bank and Gaza influence local Palestinian politics according to their size, assets and internal solidarity. In fact, the members of the PA and the local Palestinian government take into account every citizen – but particularly those with connections in the leading kinship groups, in accordance with Palestinian political culture (Khalidi, 2019). This relationship becomes clear when we examine the network of connections between leading kinship groups and representatives of the Palestinian government (the local municipality and the PA), and the mutual dependence between them. The Palestinian government depends on the support of the dominant kinship groups, and they in turn seek to influence decision making in local government according to their interests. Local government acts to protect the rights of all residents, but it seems that this protection may be diminished when it contradicts the joint interests of the dominant kinship groups and the local government, as arose in the case of the new kiln. We will try to illustrate this point through evidence that arose during the research.

The impression we received was that, despite their allegiance to the local tradition of charcoal production, the leaders of the Abed Al Kabir and Abu Jalid kinship groups were well aware of the global trends against air pollution and the severe problem of air pollution in the region caused by the traditional kilns. Therefore, they expected that a change in policy would happen sooner or later, with or without their agreement, and that they must initiate steps to deal with the expected legal decision that is likely to decimate the traditional charcoal production industry. These insights brought them to an alternative solution – importing charcoal from Egypt – and they expanded imports accordingly. As the only charcoal importers in the region, they maintained their control of the charcoal industry and even strengthened their status; as the success of their import business increased, so did their opposition to new technology. Their status also became stronger as a result of their joint interest with the local municipality, which charged 17% import tax on charcoal from Egypt, while local charcoal production was not charged any taxes at all. The income from taxes grew with the increase in charcoal imports, and this is one of the explanations for local government opposition to the new kiln. An example of this cooperation was observed with the completion of the construction and prior to the initial operation, when a rumor and intimidation campaign began in Zabed, led by the strong kinship groups, concerning the harm that was likely to be caused to residents by the new kiln. This was described by one of the installers:

One day a senior manager from the Zabed municipality came and said: “Tell me when the experiment will be – I’ll move the people of the village far away”. I asked “Why?” He said to me: “They say that there will be a big explosion…” I said “Why?” He said “That’s what the people heard… I told them not to be afraid, I’m here with my children and if there is an explosion I’ll be the first one to blow up.” I promised them that there would be no explosion… lots of people didn’t want to believe and kept saying there will be an explosion for sure… they didn’t let me work… everyone came around me as if to give me advice… but they actually interrupted my work. Some of them offered to help me and I was worried they would harm the kiln and refused.

The members of the local government, who heard the rumors, immediately demanded additional safety checks before giving approval to operate the kiln. They asked for different clarifications from the planning team through the CA and demanded that they present safety approvals, delaying the operation of the kiln for several extra weeks. The requirements of Israel’s Ministry for Environmental Protection for the continuous monitoring of air pollution around the new kiln enabled use of a similar tactic to interfere with its operation, backed by the local government. Continuous monitoring of air pollution requires a connection to the internet. Disruptions to the internet stemmed, among other causes, from the sudden disappearance of parts of the system, which lead to additional expenses and delays while missing parts were installed. Internet connection problems occurred before each planned operation of the new kiln, but requests from the local municipality to fix the issues were generally ignored. Even after promises were received that the issues would addressed, a timeframe was not designated and explanations and complaints about interruptions to the experiment were of no avail. In this way, the monitoring of air pollution during the operation of the new kiln was prevented and its opponents continued to spread rumors that the kiln polluted more than the traditional kilns.

In a meeting with stakeholders that took place following the first operation of the new kiln, a representative of the PA presented his claims against its operation. While recognizing the need to maintain clean air, and that the operation of the kilns does cause environmental pollution, he emphasized that the livelihoods of many families would be harmed by the closing of the traditional kilns. At the same time, residents see that the amount of smoke generated by the new kiln is greater than the smoke emitted by the traditional kilns, and they see that the effort to operate it is not worthwhile. These words were supported with documents on the level of air pollution that reached the local municipality. Likewise, residents were disappointed by the delays in operating the new kiln, which was delayed by seven months. This caused them to lose faith in the CA and in the researchers who developed the kiln. The representative of the PA suggested an alternative to the new charcoal kiln – to install the traditional kilns in a closed room with the bellows developed by the researchers, and thus to allow each family to maintain its own kiln.

This evidence demonstrates the character of the political and economic collaboration, related to control and power relationships, between the strong Abed Al Kabir and Abu Jalid kinship groups and the local government. These examples highlight the overt and covert steps taken to postpone or prevent the operation of the kiln. The efforts of the strong kinship groups to delay the operation of the new kiln were successful – and even further strengthened their social status – but also helped to turn attention from their initiative to import charcoal. The opposition of the local government to change stemmed not only from an economic interest shared with these kinship groups, but also from a concern that the new kilns could unsettle the region’s exisiting social structure. In this light, we can interpret the support by the local Palestinian government of the dominant kinship groups as stemming from a desire to preserve the existing order as much as possible and to prevent unnecessary changes that could undermine their control. Another expression of their approach was to take a political-power step against the CA to ensure that they do not cross the boundaries of intervention on Palestinian land.

**3.4 Maintaining the delicate balance with the Israeli government**

According to Khalidi (2019), the impact of the Israeli occupation is expressed, in part, through core economic issues. The PA makes efforts to invest in social and economic development, but this development is limited by Israel’s political, economic and defense interests. Nevertheless, Palestinian business owners have learned to maintain sound relationships with representatives of the Israeli authorities and to protect their interests and assets. The desire of the CA is to establish a relationship of mutual respect with the Palestinian population, despite its ability to exercise command by virtue of its authority in the West Bank region. However, in the abnormal situation of life under occupation, it is evident that, under the surface, this relationship is also based on the creation and maintenance of boundaries, attempts to cross the existing boundaries, and their renewed examination. These relationships include contests over power and honor, punishment and release of tension through economic relief. The approach of the CA towards the kilns was ambivalent: on one hand, it was concerned for the wellbeing of the Palestinian population in order to build trust and ‘industrial peace’ with the PA. On the other hand, it was aware of the economic potential of the new kiln, as well as the large financial investment in constructing the kiln, making it difficult to give up on the idea.

Initially, the members of the CA believed the claims of the Abed Al Kabir and Abu Jalid kinship groups that the new charcoal kiln was defective and demanded repairs and clarifications from the development team. The subsequent delay in the timetable caused continuing air pollution. The members of the CA were forced to issue a decisive ruling, and from November 2016 the residents of Jenin and the surrounding villages were forbidden to operate the traditional kilns. This rule was published after a publicity campaign and warning that lasted an entire month, during which individual explanations were conveyed to all of the kiln owners. Subsequently, enforcement by the CA was increased, including through the confiscation of charcoal that was produced illegally and the destruction of traditional kilns.

In many ways, the ban on activating the kilns achieved its aim; within a few days, the air in the region improved and after a number of weeks it became clean and clear. In parallel, the heads of the CA summoned the representatives of the kiln owners and notified them that the kiln that was constructed in Zabed was at their disposal. Only after the general meeting of stakeholders at the initiative of Sami from the CA and the ‘presentation’ that was prepared by the dominant kinship groups, representatives from the CA raised their hands in despair. This is reflected in a later declaration by a senior manager in the CA:

“We have invested a lot of money and time to provide a good solution to the local Palestinian population, while taking into account the petitions that were submitted against us to the High Court of Justice … but as you know we did not receive the cooperation that we were expecting. It is all in your hands now, if you desire, take the kiln and enjoy using it, if you do not want the kiln you can burn rocks in it for all I care…”

At the same time that the Abed al Kabir and Abu Jalid kinship groups continued to control the charcoal industry by importing charcoal from Egypt, the residents of Zabed – following the pressure that was put on them – decided not continue their attempt to begin using the new kiln on their land. The new kiln’s development team continued with their work to prevent air pollution from the kilns, and these were distributed among the kiln owners in Egypt, who now benefit not only from charcoal production, but also from the ability to produce electricity and wood vinegar, for which applications and new markets are being developed.

In parallel, and in order to minimize economic damage, the MOA assisted the promotion of a tobacco farming in the rural area around Jenin. The CA and the MOA used economic incentives to encourage the residents of the villages to convert the kiln areas to tobacco farming (Fig. 4). Tobacco farming, which has existed in the Jenin area as an important source of income for generations, was found to be particularly suitable to the region’s soil, which over time had absorbed large quantities charcoal ash. According to the CA, the closure of the kilns spurred the residents of Zabed to increase the area of tobacco farming for a number of reasons: the clean air made the agricultural work easier and improved the quality of the tobacco; tobacco farming provided a good alternative income while taking advantage of manpower within the family; the flexible timetable of the agricultural work and the low skill level required allowed the employment of men and women of all ages. Since tobacco farming can use treated wastewater (Agricultural Staff Office, 2017), its development contributed to solving the water shortage in the region. Moreover, increasing cigarette prices in Israel and around the world made the local cigarette industry highly lucrative in both the Palestinian and the Israeli markets. Indeed, in a newspaper article entitled “The green gold near Jenin” it was reported that 90% of the families in Zabed earned a living from tobacco farming in 2017 (Kolodetsky, Actualic News, 3.7.2017).



**Fig. 4** Tobacco field in an area previously used for charcoal production.

The development of tobacco, instead of the charcoal industry, provided a solution to the demands of the High Court of Justice “not to harm the Palestinians’ livelihood”, and ensured the cooperation of the local community. Despite the power struggles and rejection of the new kiln by the strong kinship groups, the rejection was done in a sophisticated way without violence or aggression. The various meetings about the establishment of the kiln served as mechanisms for regulating the tension. Each side was given the opportunity to voice its opinion, and the Palestinian leadership preserved their self-respect. Attempts to convince the other side took place among the different bodies, with the representatives of the Israeli government avoiding direct confrontation and coercion to use the new kiln, making sure to maintain a balance between non-intervention in the final decision making about the kiln and the closure of the traditional kilns, in accordance with the messages received from the dominant kinship groups and the PA. In fact, closure of the traditional kilns was done in cooperation with the Palestinian side because of the interest of the dominant kinship groups and the local government to promote the import of charcoal from Egypt, the interest of non-kiln workers in clean air, and finding alternative employment solutions to ensure quality of life for residents, among other reasons. We presume that both the enjoyment of clean air and the improved quality of agricultural produce contributed to this.

**4 Discussion and Conclusions**

The case of the charcoal industry in the Jenin area raises ethical, social-structural and political issues regarding the introduction of innovative technologies in traditional societies. Despite suffering from air pollution, as well as health hazards and low life expectancy, the residents of the villages in the Jenin area and the local Palestinian government initiated a legal battle to prevent the closure of traditional kilns on their land.

Behind the introduction of the new kiln in Zabed stands the basic conflict resulting from the unequal relationship between the Palestinian and the Israeli governments, as a result of the Israeli occupation and control of the region. Furthermore, we note the ongoing tension between modernity and tradition and between innovation and development and opposition to change. Similarly, the conflicting appeals for the intervention of the Supreme Court by the Israelis against the Palestinians because of air pollution and by the Palestinians against the Israelis because of loss of income also created tension. To these we add the threat of a crisis in the relationship that underlay the Israeli attempt at intervention and the desire to force change on the Palestinians. Naturally, conflicts and tension also exist within Palestinian society, stemming from the mutual dependence between the Palestinian government and the dominant kinship groups and between them and the other kinship groups in the region, as well as tension within the kinship groups themselves. The attempt to introduce the new kiln provides an opportunity to shed light on the relationship between the different actors in this complex system, and allows us to elucidate the processes connected to the formation of a social order and network of connections that facilitate its stability and maintenance.

Despite the investment by Israel’s CA to finance the development of the new kiln, the dominant kinship groups, who stand at the head of the Palestinian social hierarchy, fought to prevent its introduction by building a common front with the Palestinian government and using machinations. The joint effort to maintain and strengthen the existing social structure and prevent its disintegration allowed the dominant kinship groups to achieve a victory and prevent the introduction of the new kiln. This was, of course, against the interest of the kinship groups connected to the kilns, and at the same time reinforced their status in the local community. The local Palestinian government cooperated with the dominant kinship groups, while reexamining and marking intervention boundaries for the representatives of the Israeli government. The Israeli government changed its approach to the issue, and enforced the immediate closure of the traditional kilns; as a result, air pollution ceased. Subsequently, the Israeli government led an employment revolution in the region for the benefit of tobacco farming and the expansion of agricultural crops, which merited the full cooperation from the entire population and support from the Palestinian government. The local non-kiln workers who suffered from the pollution helped to resolve the conflict as a regulating force that encouraged change in their area of residence. Although the Israeli government failed in its attempt to introduce the new kiln, at the end of the day it seems that all sides benefitted from the change: good, clean air that had not existed for generations, an improvement in the overall employment rate, preservation of the power and status of the dominant kinship groups, improved status of the Palestinian government, and from the Israeli perspective, the maintenance of peace and order.

Apparently, the case described above supports theories about the cultural dimensions (Hofstede, 2001) and the social influence of culture (Venkatesh et al., 2003, 2012) that hinder the adoption of new technologies in any society. Nevertheless, this study shows that the tendency to collectivism and the social-hierarchical structure of Palestinian society and its short-term orientation did not stop the technological change by themselves, but rather the opposition was driven by the economic interests of the dominant kinship groups alongside the economic and socio-political interests of the local Palestinian government. If the new kilns served the economic interests of the kinship groups they would have been successfully adopted. The relatively low level of education of the local kiln workers (Rogers, 1962; Mwangi and Kariuki, 2015; Uhunamure et al., 2019), as in other developing societies, was indeed part of the opposition to change, as well as their long-standing loyalty to traditional charcoal production in homemade kilns (Eseonu and Egbue, 2014; Zhao et al., 2018). However, the opposition to change was not led by the workers with a low level of education nor by the leaders of the small kinship groups, who actually were interested in the new technology, but by the leaders of the dominant kinship groups. These kinship groups are led by people with a wider education who are exposed to information and a pragmatic approach to new information, and we cannot doubt their awareness of the environmental hazard created by the traditional kilns and recognition of the upcoming change that allowed them to be one step ahead of everyone. Thus they were able to act with a long-term orientation (Hofstede, 2001) and plan their steps in an educated and calculated way, developing an alternative business of importing charcoal, and blocking the introduction of technological change because it threatened with their business interests and their status in the social structure.

Israeli researchers claim that the traditional kinship group structure and patriarchy hinder and even thwart the potential for an egalitarian approach to economic development among the rural Arab minority in Israel and for modernization and economic empowerment. Nevertheless, according to Khalidi (2019), this kind of research is conducted through an Orientalist and neocolonial lens, and assumes that the conditions of advancement in one society are also relevant to societies with different cultures. The current study emphasizes the complexity involved in introducing change and modernization in Palestinian kinship group society, and supports the claims of Khalidi that the kinship group, under certain circumstances, can act as a factor and incentive for success and development. This study shows that, despite the difficulties that the kinship group and social structure created, at the end of the day the dominant kinship groups led social change in a direction that suited the conditions that they desired. When such conditions existed, the strong kinship groups cooperated with the Israeli government’s desire to decrease air pollution, did not prevent the closure of the traditional kilns, allowed and joined the implementation of programs for social and economic development of all the region’s residents.

Analysis of this case reinforces the strength of the social structure of traditional societies and the different mechanisms ensuring its preservation. It seems that in this case, the introduction of technological change depended on not harming the existing social structure. As previously concluded by Sharp (1952), to ensure that a traditional society will not be harmed by technological change, we must determine the meaning of this change for each of the different actors in the society, and its influence on its existing social institutions. The Palestinian-Israeli case shows that the good intentions of Israel’s CA to improve the quality of life of the residents and the environment did not match the range of local needs, highlighting the importance of optimal integration of representatives from different local groups alongside experts in the field of sociology, in the planning and guidance of processes of technological innovation.

Similarly to the findings of Sen (1999), the case of the new kilns shows that a society may prefer to preserve highly valued ancient traditions in order to maintain cultural continuity, even if the economic price is high. Sen suggests that the local community should conduct a rational evaluation of its alternatives in collaboration with the different sectors of society when making decisions, rather than leaving this to the privileged. Nevertheless, as Hill et al. (2008) demonstrated, loyalty to the extended family and tradition are also reflected in loyalty to the structured positions built into the society. Therefore, we can conclude from the study on the kilns in Zabed that the seemingly hidden collaboration that developed between the privileged dominant kinship groups, the local Palestinian government and the heads of Israel’s CA served as a crucial step influencing the positive result that was achieved. The Israeli government’s retraction of its insistence to introduce the new kiln contributed to improved efficacy in managing the crisis while preserving the traditional social order alongside environmental and economic leverage to the satisfaction of all.

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